

NATIONAL GEOGRAPHIC



what's in your

mind

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A photograph of a snowy winter scene. In the foreground, a large bush is covered in a thick layer of snow. To the right, a window with a grid pattern is visible, and snow is falling or blowing in front of it. The overall scene is bright and wintry.

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"To the south we had a scene of savage magnificence, well becoming Tierra del Fuego. There was a degree of mysterious grandeur in mountain behind mountain."

CHARLES DARWIN,
JOURNAL OF RESEARCHES ON THE
VOYAGE OF THE BEAGLE, 1839



Charles Darwin recognized it at first glance: Tierra del Fuego is one of the world's most ecologically important areas.

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The result will see an irreplaceable part of the planet preserved for the benefit of future generations. And a brand-new model for conserving places still left to be protected.

To watch a brief film about this magnificent area, visit www.gs.com. To learn about the Wildlife Conservation Society, visit www.wcs.org.

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DR. STEVEN E. SANDESON,
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WILDLIFE CONSERVATION SOCIETY



"This story is a striking example of how people, capital and ideas can work together to effect important change in the world."

HENRY M. PAULSON, JR.,
CHAIRMAN/CEO,
GOLDMAN SACHS





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THE COVER

Sensors record the effect of meditation on a Buddhist teacher.

BY CARY WOLINSKY

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nationalgeographic.com/magazine

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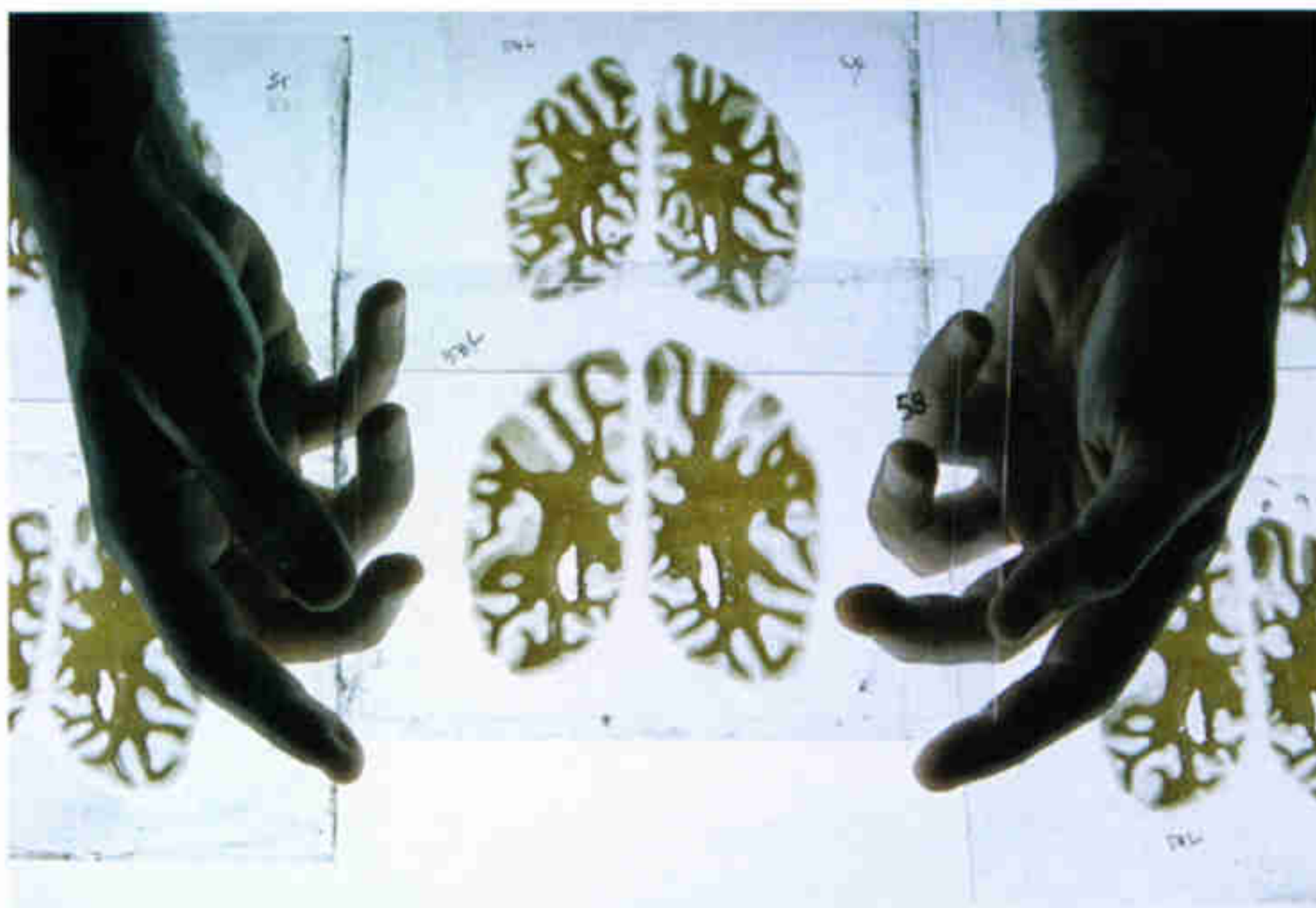
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From the Editor



CARY WOLINSKY

I think I had a brilliant idea for this page, my last as Editor in Chief, but I forget what it was. It happens to all of us: Thoughts flash through our minds and just vanish. Figuring out why is one of the great mysteries of the mind, which we set out to explore in the pages of this issue. Not an easy task: How do you visualize the mind? How do you describe the mind? Go inside the mind? Picture it?

I'm happy to report that writer James Shreeve and photographer Cary Wolinsky came up with a plan to lead us on a journey of exploration as strange and wonderful as any of the great 16th-century voyages of discovery.

As I leave the Society after 35 years, including the last ten as Editor in Chief of NATIONAL GEOGRAPHIC, my mind is filled with fond memories of people and places around the world. I have been honored to work with a superb staff and with contributors who enlightened us all. I have been able to participate in the thrill of the discovery of *Titanic* and experience a quiet dawn on a mountaintop overlooking the ancient Jordanian city of Petra. I've ridden with Bedouin police and witnessed the birth of a volcano. My heart holds all these experiences as treasures.

For the last time I thank you, the members, for your support of the Society and for giving us the chance to explore the world with you. The journey of the world's magazine continues.

Bill Allen

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Every day Sandra Sessoms-Penny faces a school of energetic students. Every day she faces their unending questions. Every day she faces eight hours that often feel like twenty. And every day she doesn't give up. Sure, she could be working in an office building, making more money, never getting hit in the head with a French fry at lunch. But Sandra is the kind of assistant principal who welcomes every aspect of her job. Because being one of the first female electricians in the U.S. Air Force and rising through the ranks to become Senior Master Sergeant taught her how to embrace a challenge. Or two.

DETERMINATION

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U.S. AIR FORCE 1973-1995

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NATIONAL GEOGRAPHIC
CHANNEL



SPECIAL PRESENTATION

SUNDAY, MARCH 6, 8 P.M. ET/9 P.M. PT

In the Womb This two-hour special takes us inside a mother's body to witness how a single cell divides millions of times and grows into a thinking, feeling baby.

Watch a fetus develop its nerve cells, heart, arms and legs, and see the fetus open its eyes inside its dark, watery world. Pioneering medical imaging technology, called 4-D ultrasound, reveals in detail the variety of a fetus's reflexes such as sucking its thumb, blinking, yawning, smiling, and even crying. Follow along as the fetus starts reacting to light and sound from outside the womb and learns how to recognize voices.

In the Womb also features stunning images from in utero surgery as a doctor inserts a fetoscope through the mother's womb and into the fetus in a procedure to correct a congenital defect.

From conception to birth, *In the Womb* offers the most intimate glimpses into the months before birth.

SUNDAYS AT 8 P.M. ET/PT

EXPLORER Venture to the front lines of the most compelling stories of our time with National Geographic Channel's celebrated documentary series *Explorer*. Hosted by Lisa Ling, each program takes you deep into the realms of adventure and exploration, culture and politics, science and natural history. Tune in to upcoming episodes to learn all about the amazing discovery of a prehistoric species of tiny humans in Indonesia, and witness the challenges and violence of daily life inside a maximum security prison.

SUNDAY, MARCH 20

9-11 P.M. ET/PT

Search for the Ultimate Survivor

We thought we knew how humans evolved, but it turns out there's a lot more to the story. Over



time many species of humans evolved but became extinct. Why did *Homo sapiens* thrive? Scientists are unearthing startling new finds that are rewriting human history. Tune in to find out how our ancestors competed and why we ended up on top.

Find out what's on and how to get the Channel in your area at nationalgeographic.com/channel. Programming information is accurate at press time. Consult local listings.

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THE MIND How good are you at reading faces? Participate in an international online survey that will further the science of facial-expression interpretation.

■ **TEST YOURSELF** against one of the country's top cops and *Monty Python* actor John Cleese. ngm.com/survey2005



EMERGING EXPLORERS National Geographic has discovered the next generation of explorers—from a space architect to a real-life Lara Croft—and is helping them realize their potential.

■ **WHO MADE THE CUT?** Meet the explorers and experience their adventures at nationalgeographic.com/emerging.

PHOTO OF THE DAY

Get your photo fix. There's a new picture every day at nationalgeographic.com/photography/today.

PHOTOGRAPHY

Explore online galleries of the magazine's best unpublished photographs from all of our feature stories since 2000. Get tips from the photographers about camera, light, and film choices at nationalgeographic.com/magazine.

WHERE WE COME FROM, NICE GUYS FINISH FIRST.

Really. You see, we are not your typical \$300 billion financial services group. Not by a long shot. With our long nonprofit heritage, we have spent over 85 years working off one unique premise – serve those who serve the rest of us. Today, we continue that mission by helping to ensure the long-term financial well-being of people in the academic, medical and cultural fields. You know, the nice guys. People like nurses, teachers, researchers, custodians, musicians and millions more like them whose career choices inherently add value to the greater good of society. Because they put the needs of others first in their lives, they will always come first in ours.

For more information go to www.tiaa-cref.org.



Behind the Scenes



TRAVELS

Partner Ship

National Geographic is about to float a new idea. This month, Lindblad Expeditions—a Society partner—will transform one of its six ships, *Endeavour* (above), into *National Geographic Endeavour*. What's in a name? A lot, actually. "We're both in the business of illuminating people about what's out there," says Sven Lindblad, company president. In addition to its onboard Society experts, underwater exploration equipment, and Geographic books, maps, and magazines for guests, the newly named ship will reserve space for research on projects including pioneering underwater photography. The inaugural voyage of *National Geographic Endeavour* will be an April cruise from Valparaíso, Chile, to the Panama Canal. For more on Lindblad Expeditions, go to expeditions.com.

NATIONAL GEOGRAPHIC BEE

It's Time to Study



Andrew Wojtanik had long outgrown the map his parents, Daniel and Dianna (left, behind Andrew), painted on his bedroom wall when he was nine. "At the national level of the Bee," said the 15-year-old, who represented Kansas in the 2004 National Geographic Bee championship, "it's hard to find a good geography study guide." So he created his own, compiling facts about politics, economies, languages, climates, and more. And 432 pages later, he'd won the Bee's \$25,000 scholarship prize. To help this year's Bee contestants study, a version of Andrew's homemade tome, *Afghanistan to Zimbabwe*, may be purchased at bookstores or online at nationalgeographic.com.

THE MIND (PAGE 2)

Get More

To learn more about a subject covered in this issue, try these National Geographic Society products and services. Call 1-888-225-5647 or log on to nationalgeographic.com for more information. ■ **In Your Face: Survey 2005** Further the study of the mind by participating in this global online survey of facial-expression interpretation at ngm.com/survey2005.

■ **Mysteries of the Mind** Learn more about the human mind and modern neuroscience with Richard Restak's comprehensive book (\$35).

Calendar

FEBRUARY

17 "Peru, Native and Viceregal" exhibit. Explore centuries of Peru's cultural history. National Geographic Museum, Washington, D.C.

MARCH

2 "Tutankhamun and the Golden Age of the Pharaohs" exhibit. Tickets go on sale for the June 16 opening at the Los Angeles County Museum of Art. See more than 130 objects from Tut's tomb on this first stop of the exhibit's four-city tour. Call 1-877-TUT-TKTS or go online to kingtut.org.

16 National Geographic's Strange Days on Planet Earth. An episode of the series is part of the "Environmental Film Festival in the Nation's Capital" held at National Geographic in Washington, D.C.

APRIL

12 Frans Lanting presents his rain forest photographs at Chicago's Field Museum.

14 "Chimpanzees, Tools, and Termites" lecture. Elizabeth Lonsdorf talks about primates at the State Theatre in Minneapolis. Call 612-673-0404 for tickets.

20 National Geographic's Strange Days on Planet Earth premieres on PBS at 9 p.m. ET/PT. Series episodes *Invaders* and *One Degree Factor* air April 20. *Predators* and *Troubled Waters* air April 27.

Calendar dates are accurate at press time; please go to nationalgeographic.com or call 1-800-NGS-LINE (647-5463) for more information.

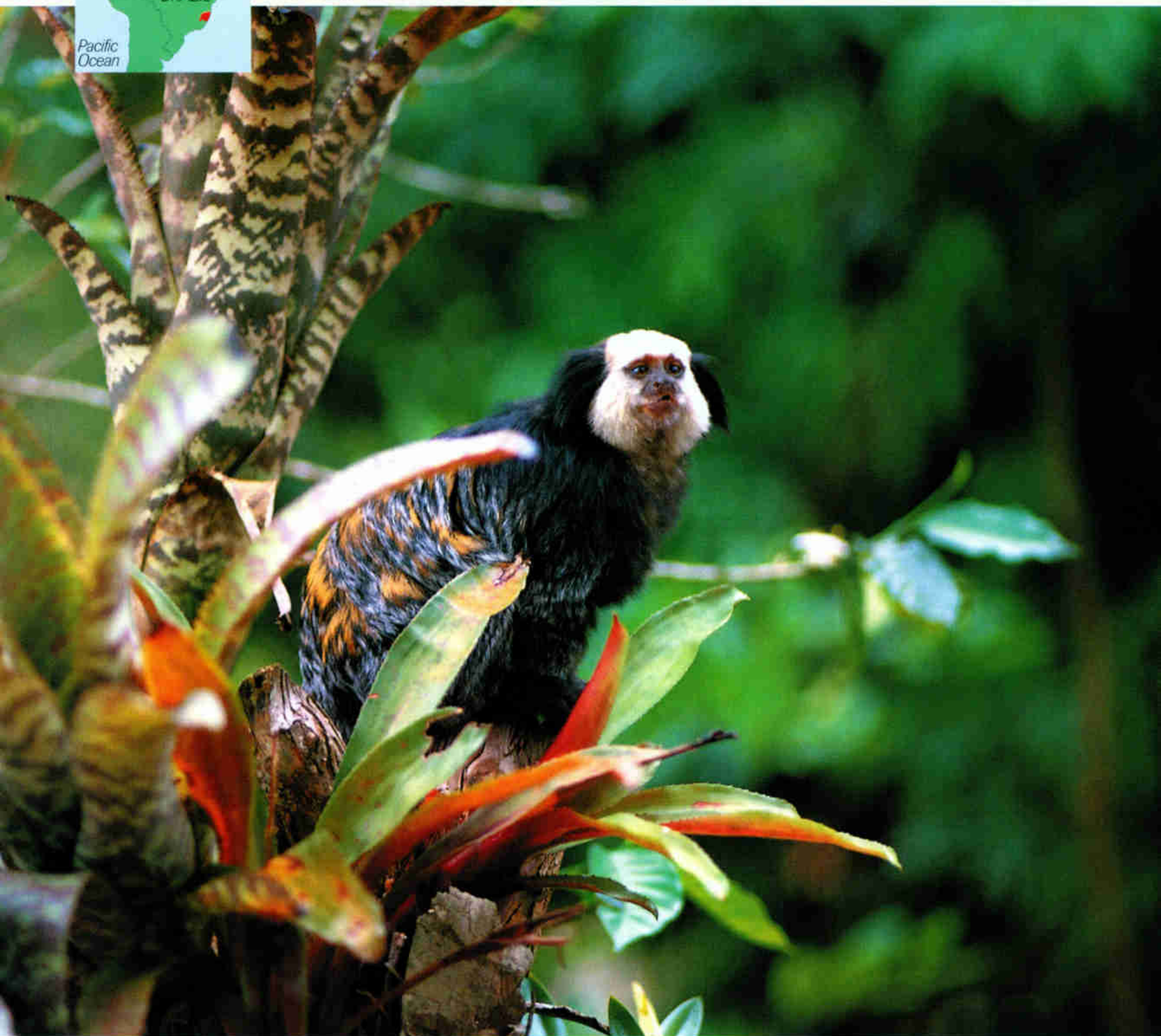


Geoffroy's Tufted-ear Marmoset (*Callithrix geoffroyi*)

Size: Head and body length, 18-23 cm; tail, 27-29cm **Weight:** 190-350 g

Habitat: Coastal secondary, lowland, evergreen and semi-deciduous forests of eastern Brazil

Surviving number: Unknown; populations declining



Photographed by Luiz Claudio Marigo

WILDLIFE AS CANON SEES IT

Uncommon senses meet common sense. Superbly sharp hearing allows Geoffroy's tufted-ear marmoset to communicate at pitches too high for the human ear to register. Smell comes into play as the dominant female secretes pheromones to prevent other females in the family group from ovulating. The little tree dweller is also big on common sense. When it sees a troop of army ants, for instance, it follows them; that way, it can make a

meal of the insects and small animals that climb the trees to escape the ants. This makes a nice change from its usual diet of fruits and tree gum. But these trees are an uncertain home, threatened by relentless deforestation.

As an active, committed global corporation, we join worldwide efforts to promote awareness of endangered species. Just one way we are working to make the world a better place—today and tomorrow.



From the President



NATIONAL GEOGRAPHIC PHOTOGRAPHER MARK THIESSEN

This issue marks a major milestone for a publication that has had many. Bill Allen, at center, Editor in Chief of NATIONAL GEOGRAPHIC magazine, has retired, and Associate Editor Chris Johns has succeeded him. We at the Society and you our loyal members owe much to Bill, who steps down after completing ten remarkable years as Editor and more than 35 years with our organization.

Bill's magnificent obsession has been to deliver the highest quality journalism in the service of our mission. On his watch NATIONAL GEOGRAPHIC has grown into a truly international publication. When Bill became Editor on January 1, 1995, the magazine was available only in English; now it's read around the world in 24 different languages. And, like the world it serves, the magazine has continued to evolve, bringing its unique perspective to ever more topical and timely stories—from global warming and the oil crisis to obesity, evolution, and human slavery.

In his years as Editor, Bill has developed a talented team that is now in place to pick up the torch as he passes it. Chris Johns, only the ninth full-time Editor the Society has named in 117 years, embodies the NATIONAL GEOGRAPHIC. A celebrated photographer and author, Chris brings two decades of experience with the magazine to his new assignment. He shares our passionate belief that a fresh perspective and good stories about subjects that matter can truly change the world for the better. He and his colleagues will be building on the foundation of excellence that Bill Allen leaves behind.

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Important considerations: ZOCOR is a prescription tablet and isn't right for everyone, including women who are nursing or pregnant or who may become pregnant, and anyone with liver problems. Unexplained muscle pain or weakness could be a sign of a rare but serious side effect and should be reported to your doctor right away. ZOCOR may interact with other medicines or certain foods, increasing your risk of getting this serious side effect. So tell your doctor about any other medications you are taking.

ASK YOUR DOCTOR IF ZOCOR IS RIGHT FOR YOU. PLEASE READ THE MORE DETAILED INFORMATION ABOUT ZOCOR IMMEDIATELY FOLLOWING THIS AD.

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(SIMVASTATIN)

PLEASE READ THIS SUMMARY CAREFULLY, THEN ASK YOUR DOCTOR ABOUT ZOCOR. NO ADVERTISEMENT CAN PROVIDE ALL THE INFORMATION NEEDED TO PRESCRIBE A DRUG. THIS ADVERTISEMENT DOES NOT TAKE THE PLACE OF CAREFUL DISCUSSIONS WITH YOUR DOCTOR. ONLY YOUR DOCTOR HAS THE TRAINING TO WEIGH THE RISKS AND BENEFITS OF A PRESCRIPTION DRUG FOR YOU.

USES OF ZOCOR

ZOCOR is a prescription drug that is indicated as an addition to diet for many patients with high cholesterol. For patients at high risk of coronary heart disease (CHD) because of existing heart disease, diabetes, vascular disease, or history of stroke, ZOCOR is indicated along with diet to reduce the risk of death by reducing coronary death; reduce the risk of heart attack and stroke; and reduce the need for revascularization procedures.

WHEN ZOCOR SHOULD NOT BE USED

Some people should not take ZOCOR. Discuss this with your doctor.

ZOCOR should not be used by patients who are allergic to any of its ingredients. In addition to the active ingredient simvastatin, each tablet contains the following inactive ingredients: cellulose, lactose, magnesium stearate, iron oxides, talc, titanium dioxide, and starch. Butylated hydroxyanisole is added as a preservative.

Patients with liver problems: ZOCOR should not be used by patients with active liver disease or repeated blood test results indicating possible liver problems. (See WARNINGS.)

Women who are or may become pregnant: Pregnant women should not take ZOCOR because it may harm the fetus. **Women of childbearing age should not take ZOCOR unless it is highly unlikely that they will become pregnant.** If a woman does become pregnant while on ZOCOR, she should stop taking the drug and talk to her doctor at once.

Women who are breast-feeding should not take ZOCOR.

WARNINGS

Muscle: Tell your doctor right away if you experience any unexplained muscle pain, tenderness, or weakness at any time during treatment with ZOCOR so your doctor can decide if ZOCOR should be stopped. Some patients may have muscle pain or weakness while taking ZOCOR. Rarely, this can include muscle breakdown resulting in kidney damage. The risk of muscle breakdown is greater in patients taking certain other drugs along with ZOCOR:

- Cyclosporine, itraconazole, ketoconazole, erythromycin, clarithromycin, telithromycin, HIV protease inhibitors, the antidepressant nefazodone, or large quantities of grapefruit juice (>1 quart daily), particularly with higher doses of ZOCOR.
- Gemfibrozil particularly with higher doses of ZOCOR.
- Other lipid lowering drugs (other fibrates or ≥ 1 g/day of niacin) that can cause myopathy when given alone.
- Danazol particularly with higher doses of ZOCOR.
- Amiodarone or verapamil with higher doses of ZOCOR.

The risk of muscle breakdown is greater at higher doses of simvastatin.

Because the risk of muscle side effects is greater when ZOCOR is used with the products listed above, the combined use of these products should be avoided unless your doctor determines the benefits are likely to outweigh the increased risks.

The dose of ZOCOR should not exceed 10 mg daily in patients receiving gemfibrozil. The combined use of ZOCOR and gemfibrozil should be avoided, unless your doctor determines that the benefits outweigh the increased risks of muscle problems. Caution should be used when using ZOCOR with other fibrates or niacin because these can cause muscle problems when taken alone.

No more than 10 mg/day of ZOCOR should be taken with cyclosporine or danazol.

The combined use of verapamil or amiodarone with doses above ZOCOR 20 mg should be avoided unless your doctor determines the benefits outweigh the increased risk of muscle breakdown.

Your doctor should also carefully monitor for any muscle pain, tenderness, or weakness, particularly during the initial months of therapy

and if the dose of either drug is increased. Your doctor also may monitor the level of certain muscle enzymes in your body, but there is no assurance that such monitoring will prevent the occurrence of severe muscle disease.

The risk of muscle breakdown is greater in patients with kidney problems or diabetes.

If you have conditions that can increase your risk of muscle breakdown, which in turn can cause kidney damage, your doctor should temporarily withhold or stop ZOCOR[®] (simvastatin). Also, since there are no known adverse consequences of briefly stopping therapy with ZOCOR, treatment should be stopped a few days before elective major surgery and when any major acute medical or surgical condition occurs. Discuss this with your doctor, who can explain these conditions to you.

Liver: About 1% of patients who took ZOCOR in clinical trials developed elevated levels of some liver enzymes. Patients who had these increases usually had no symptoms. Elevated liver enzymes usually returned to normal levels when therapy with ZOCOR was stopped.

In the ZOCOR Survival Study, the number of patients with more than 1 liver enzyme level elevation to greater than 3 times the normal upper limit was no different between the ZOCOR and placebo groups. Only 8 patients on ZOCOR and 5 on placebo discontinued therapy due to elevated liver enzyme levels. Patients were started on 20 mg of ZOCOR, and one third had their dose raised to 40 mg.

Your doctor should perform routine blood tests to check these enzymes before you start treatment with ZOCOR and thereafter when clinically indicated. Patients titrated to the 80-mg dose should receive an additional test at 3 months and periodically thereafter (eg, semiannually) for the first year of treatment. If your enzyme levels increase, your doctor should order more frequent tests. If your liver enzyme levels remain unusually high, your doctor should discontinue your medication.

Tell your doctor about any liver disease you may have had in the past and about how much alcohol you consume. ZOCOR should be used with caution in patients who consume large amounts of alcohol.

PRECAUTIONS

Drug Interactions: Because of possible serious drug interactions, it is important to tell your doctor what other drugs you are taking, including those obtained without a prescription. You should also tell other doctors who are prescribing a new medicine for you that you are taking ZOCOR. ZOCOR can interact with the following:

- Itraconazole
- Ketoconazole
- Erythromycin
- Clarithromycin
- Telithromycin
- HIV protease inhibitors
- Nefazodone
- Cyclosporine
- Large quantities of grapefruit juice (>1 quart daily)

The risk of myopathy is also increased by gemfibrozil and to a lesser extent other fibrates and niacin (nicotinic acid) (≥ 1 g/day).

The risk of muscle breakdown is increased with other drugs:

- Danazol
- Amiodarone
- Verapamil

Some patients taking lipid-lowering agents similar to ZOCOR and coumarin anticoagulants (a type of blood thinner) have experienced bleeding and/or increased blood clotting time. Patients taking these medicines should have their blood tested before starting therapy with ZOCOR and should continue to be monitored.

Central Nervous System Toxicity; Cancer, Mutations, Impairment of Fertility: Like most prescription drugs, ZOCOR was required to be tested on animals before it was marketed for human use. Often these tests were designed to achieve higher drug concentrations than humans achieve at recommended dosing. In some tests, the animals had damage to the nerves in the central nervous system. In studies of mice with high doses of ZOCOR, the likelihood of certain types of cancerous tumors increased. No evidence of mutations of or damage to genetic material has been seen. In 1 study with ZOCOR, there was decreased fertility in male rats.

Pregnancy: Pregnant women should not take ZOCOR because it may harm the fetus.

Safety in pregnancy has not been established. In studies with lipid-lowering agents similar to ZOCOR, there have been rare reports of birth defects of the skeleton and digestive system. Therefore, women of childbearing age should not take ZOCOR unless it is highly unlikely they will become pregnant. If a woman does become pregnant while taking ZOCOR, she should stop taking the drug and talk to her doctor at

once. The active ingredient of ZOCOR® (simvastatin) did not cause birth defects in rats at 3 times the human dose or in rabbits at 3 times the human dose.

Nursing Mothers: Drugs taken by nursing mothers may be present in their breast milk. Because of the potential for serious adverse reactions in nursing infants, a woman taking ZOCOR should not breast-feed. (See WHEN ZOCOR SHOULD NOT BE USED.)

Pediatric Use: ZOCOR is not recommended for children or patients under 10 years of age.

Geriatric Use: Higher blood levels of active drug were seen in elderly patients (70–78 years of age) compared with younger patients (18–30 years of age) in 1 study. In other studies, the cholesterol-lowering effects of ZOCOR were at least as great in elderly patients as in younger patients, and there were no overall differences in safety between elderly and younger patients over the 20–80 mg/day dosage range. Of the 7 cases of myopathy/rhabdomyolysis among 10,269 patients on ZOCOR in another study, 4 were aged 65 or more (at baseline), 1 of whom was over 75.

SIDE EFFECTS

Most patients tolerate treatment with ZOCOR well; however, like all prescription drugs, ZOCOR can cause side effects, and some of them can be serious. Side effects that do occur are usually mild and short-lived. Only your doctor can weigh the risks versus the benefits of any prescription drug. In clinical studies with ZOCOR, less than 1.5% of patients dropped out of the studies because of side effects. In 2 large, 5-year studies, patients taking ZOCOR experienced similar side effects to those patients taking placebo (sugar pills). Some of the side effects that have been reported with ZOCOR or related drugs are listed below. This list is not complete. Be sure to ask your doctor about side effects before taking ZOCOR and to discuss any side effects that occur.

Digestive System: Constipation, diarrhea, upset stomach, gas, heartburn, stomach pain/cramps, anorexia, loss of appetite, nausea, inflammation of the pancreas, hepatitis, jaundice, fatty changes in the liver, and, rarely, severe liver damage and failure, cirrhosis, and liver cancer.

Muscle, Skeletal: Muscle cramps, aches, pain, and weakness; joint pain; muscle breakdown.

Nervous System: Dizziness, headache, insomnia, tingling, memory loss, damage to nerves causing weakness and/or loss of sensation and/or abnormal sensations, anxiety, depression, tremor, loss of balance, psychic disturbances.

Skin: Rash, itching, hair loss, dryness, nodules, discoloration.

Eye/Senses: Blurred vision, altered taste sensation, progression of cataracts, eye muscle weakness.

Hypersensitivity (Allergic) Reactions: On rare occasions, a wide variety of symptoms have been reported to occur either alone or together in groups (referred to as a syndrome) that appeared to be based on allergic-type reactions, which may rarely be fatal. These have included 1 or more of the following: a severe generalized reaction that may include shortness of breath, wheezing, digestive symptoms, and low blood pressure and even shock; an allergic reaction with swelling of the face, lips, tongue, and/or throat with difficulty swallowing or breathing; symptoms mimicking lupus (a disorder in which a person's immune system may attack parts of his or her own body); severe muscle and blood vessel inflammation, sometimes including rash; bruises; various disorders of blood cells (that could result in anemia, infection, or blood clotting problems) or abnormal blood tests; inflamed or painful joints; hives; fatigue and weakness; sensitivity to sunlight; fever, chills; flushing; difficulty breathing; and severe skin disorders that vary from rash to a serious burn-like shedding of skin all over the body, including mucous membranes such as the lining of the mouth.

Other: Loss of sexual desire, breast enlargement, impotence.

Laboratory Tests: Liver function test abnormalities including elevated alkaline phosphatase and bilirubin; thyroid function abnormalities.

NOTE: This summary provides important information about ZOCOR. If you would like more information, ask your doctor or pharmacist to let you read the prescribing information and then discuss it with them.



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THROUGH A PHOTOGRAPHER'S EYE

Visions of Earth



A large flock of starlings is captured in flight, forming a dense, funnel-shaped pattern that tapers from the bottom left towards the center of the frame. The birds are silhouetted against a vibrant, orange-hued sunset sky. The background shows a gradient of colors from deep orange at the bottom to a darker, almost black sky at the top. The bottom of the image shows the dark silhouette of a mountain range.

NORTHERN SPAIN

A funnel storm of starlings explodes across the sky, flowing in perfect unison. It was the birds' nightly December ritual at a lake near Logroño, and it took me several days of shooting to catch them against a rose-orange backdrop. In minutes the flock would disappear, settling into a reed bed for the night. I had hoped to experience the scene again, so I returned to the lake the following winter—but the birds didn't.

—José L. Gómez de Francisco

► Decorate your desktop with this image of starlings in flight at nationalgeographic.com/magazine/0503.

Forum

November 2004

Some of the most passionate letters we've received within the past year were in response to our most topical stories—"Was Darwin Wrong?" "Global Warning," and "The End of Cheap Oil." The more than 600 letters we received in response to Darwin focused on the same main points. A selection of these letters—chosen to reflect the variety and weight of your opinions—follows.



Was Darwin Wrong?

I sat down in the doctor's office and noticed that several people were staring at a patient reading NATIONAL GEOGRAPHIC with the huge red print, "Was Darwin Wrong?" I thought: Is NATIONAL GEOGRAPHIC compromising its scientific objectivity to gain subscriptions from the religious right? The other patients and I could hardly have been more distracted if the lizard on the cover came walking through the room. Finally, the reader was called in. As she put the magazine on the table, three of us went for it. What a brilliant title! I never did get to read it in the office, but when I got home that evening and dove into my copy, I was delighted. The anxiety and wait were worth it.

RICK ANDERSON
White Sulphur Springs, Montana

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I must congratulate you. Your article on evolution manages to be confrontational, arrogant, inflammatory, and condescending, all without being particularly illuminating. You surmise that an intelligent individual should quickly realize evolution's veracity, yet you fail to provide any new evidence. Worse, you do not address any of the gaping holes in the theory that lead so many reasoned people to question evolution.

KELLY OLSON
Los Angeles, California

I wonder if what science has really discovered is God's toolshed. The door has been opened slightly, and we are just now beginning to comprehend that perhaps God used the process of natural selection to create us and all the creatures on Earth. Perhaps Adam and Eve were just the first *Homo sapiens* to walk the Earth. I hope that in my lifetime the theories of evolution and creation will merge, because the truth in each is overwhelming.

KEVIN D. MCARTOR
Malta, Illinois

Laurels to the staff for the courage to publish the brilliant discourse on evolution. David



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EMERGING EXPLORER KIRA SALAK If it's unexpected, risky, and off the beaten path, chances are Kira Salak has done it. Always ready to break new ground, the daring writer and adventurer has kayaked solo down West Africa's Niger River; cycled 700 miles across Alaska; become the first woman to traverse Papua New Guinea; explored remote corners of Madagascar, Mozambique, and Bangladesh; and is eager to cross Mongolia on horseback next. Covering ground and stories others never reach, Kira reveals a world of unknown hazards, horrors, and hope.

Following adventure into the unknown

"I'VE ALWAYS HAD AN OVERWHELMING CURIOSITY to see parts of the world that are unfamiliar and undocumented. And I love the personal challenge of making these trips alone. Kayaking down the Niger River in Mali started with a desire to explore a place most people never see in a way that let me have a really intimate experience with the local people. In Papua New Guinea, most villagers I met had never seen a white person before. But from Libya to Borneo, when you get beyond politics and superficial cultural differences, I find we're all concerned with the same things—peace, happiness, success for our children, and having the best standard of living."

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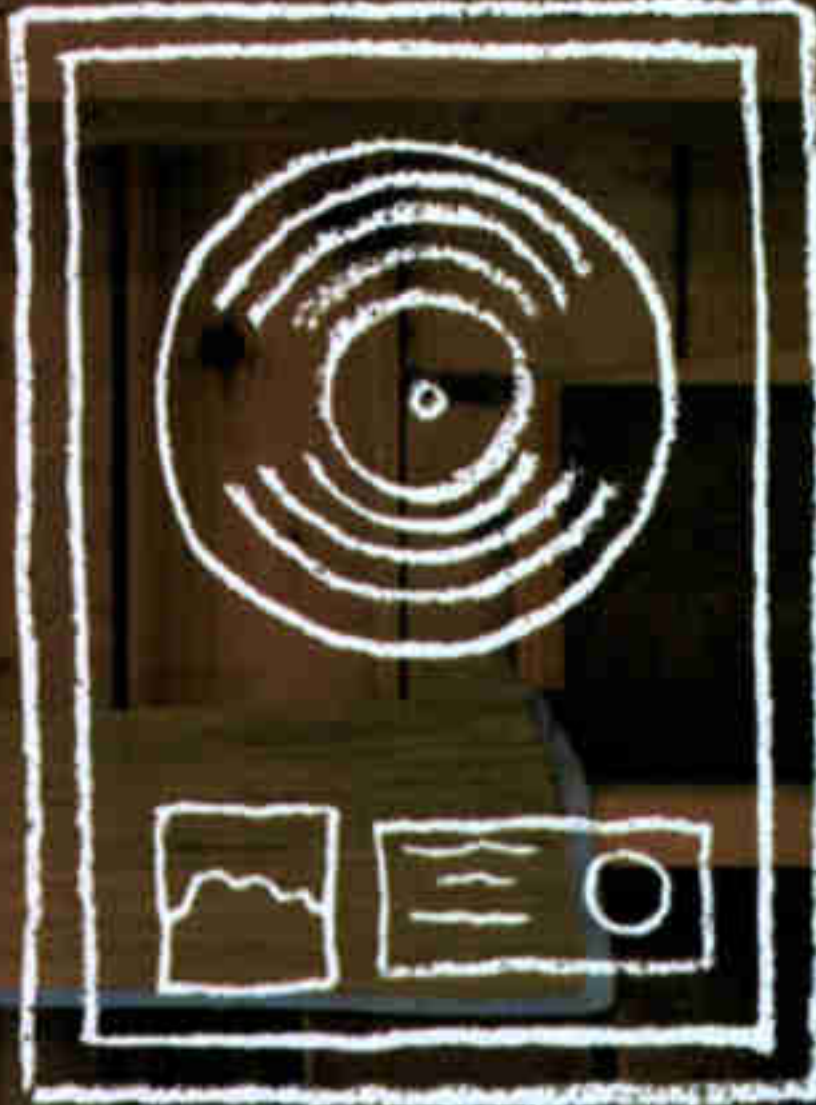
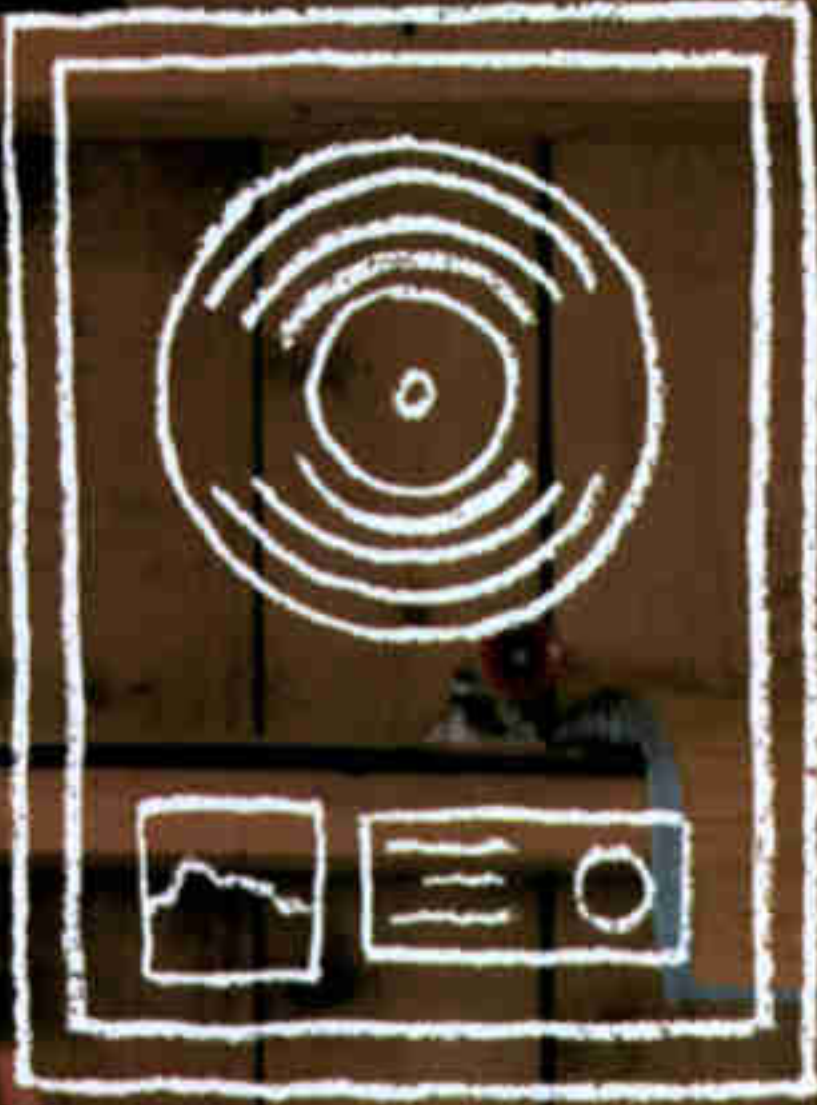
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"I SEEK OUT DIFFICULT, DANGEROUS SITUATIONS no one else is covering. Slavery in Timbuktu...civil war in Mozambique...genocide in Congo. If by shedding light on these tragedies, I can improve even one person's life, I feel it's worth the risk. Often I'm told those trips are too unsafe to make. But ever since I was a child, if someone tells me I can't do something, it empowers me all the more. I just eat that up."

—Kira Salak, Writer, Adventurer



Since 2003, the National Geographic Emerging Explorers program has identified and supported rising talents who are pioneering discoveries in a wide range of fields. Recognizing the crucial role technology plays in exploration, Microsoft has supported this program since its inception and is proud to continue that commitment by helping an extraordinary new generation of explorers realize their potential.

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EMERGING EXPLORERS

> UPDATE

Visit National Geographic online to see and hear more about Kira Salak and download photos and video clips of her journeys. Check back regularly for profiles on the 2005 Emerging Explorers, and updates on the work of our past grantees, brought to you by Microsoft.

Visit nationalgeographic.com/emerging to see and hear the Emerging Explorers.

World Supplement Map

One of the joys of being a National Geographic Society member is the excitement I see in my seven-year-old when he sees each issue's fine maps. This time his enthusiasm was unchartable. The "Earth at Night" map was on his wall in about ten seconds.

RICK THOMSON
Edmonton, Alberta

The immensity of the Great Plains was powerfully demonstrated in the "Earth at Night" map. Save for the lights strung like pearls east to west that define small communities founded adjacent to rail lines and highways, the black void of the Great Plains pronounces its defiant effect on human settlement.

TOM TITTEMORE
Calgary, Alberta

The political boundary between brightly lit South Korea and lights-out North Korea is striking. It speaks volumes about how well—or poorly—the respective governments are providing for their citizens.

ROBERT M. KRUG
Nazareth, Pennsylvania

I would show my kids a picture of their home state at night on the map, but much to our disappointment, Hawaii is missing.

BRYAN ROSS
Honolulu, Hawaii

In order to show greater detail in populated mainland areas, we decided to "zoom in," thus cropping out the largely unpopulated Pacific Ocean.



Unfortunately, that meant excluding Hawaii.

Medford, Idaho Falls, but no Green Bay? Perhaps a metro population of a quarter of a million people does not certify inclusion in your map insert.

THOMAS L. ZEISE
Green Bay, Wisconsin

In more densely populated areas we had to pick and choose which cities to name on the map. But in less populated regions, such as the western U.S., we could label many more.

Quammen's article compels science teachers like me to stand up and cheer for his lucid writing, which promotes acceptance of this seminal concept of biological science.

JOHN OCCHUIZZO
Greensburg, Pennsylvania

I found that, according to the author, my own skepticism of evolution is the result of interference, confusion, and ignorance. Well, this was news to me; I always considered my thoughts on the subject as based

on facts and science. As I continued to read, I found myself agreeing with the author that our understanding of evolution is of enormous importance, but for a very different reason than his. Clearly, if we can prove that we are highly evolved animals, then we can live by our "true" and natural instincts. Surely the author is aware that Nazis used evolutionary and survival-of-the-fittest arguments as justifications.

DAN STIMPSON
Monterey, California

I am not surprised that nearly half of all Americans believe "God alone, and not evolution, produced humans." When I look at my three beautiful children, it is hard to believe they are the end result of evolving Eocene pond scum.

My father-in-law, on the other hand, may be the evidence you've been looking for.

TOBY PITTS
Baltimore, Maryland

The Geography of Terror

I found your article incomplete and unsatisfying. It seems you are only interested in violence when it is perpetrated by non-governmental actors. Does it really matter if a person is killed by a crude bomb or a professional soldier? Murder is murder regardless of what we choose to call the murderer.

FERGAL MULLALLY
Austin, Texas

We are told that terrorists are filled with hate. However, people are not born with hate. It is beaten into them gradually. To the people of many countries,

WRITE TO FORUM National Geographic Magazine, PO Box 98199, Washington, DC 20090-8199, or by fax to 202-828-5460, or via the Internet to ngsforum@nationalgeographic.com. Include name, address, and daytime telephone. Letters may be edited for clarity and length.

the U.S. is the bully with the stick, if not directly, then by its economic, military, or covert support of oppressive regimes.

ELISA BRABENEC
Suttons Bay, Michigan

The history on terror failed to take note of perhaps the biggest terrorist attack on a civilian population before September 11: the bomb blasts in Bombay [Mumbai], India, on March 12, 1993. The blasts, set off in serial fashion through several locales of Bombay on a working day, killed at least 250 people and injured many more. India continues to be under attack from various terrorist groups.

SRIDHAR KOLINJAVADI
Parlin, New Jersey

Others also wrote in about terrorist acts or groups that were omitted. Neither the article nor the maps were meant to be exhaustive lists. They were representative of types of terrorist groups, their activities, and their geographic range.

Fiji's Rainbow Reefs

Flipping through these pages is like a trip around the world. Warm colors spill out around me, and I soon find myself up close and personal with places I only ever traveled to in my imagination. I feel like I can reach into the page and suddenly be submerged in the warm waters of Fiji. It is simply amazing.

RACHEL BELGARD
Portland, Oregon

Monsoon Madness

If the photo of the croc (pages 100-101) has not been enhanced or manipulated, then the croc swallowed a lightbulb that was turned on.

GARY KRUEGER
Montrose, California

This is, in fact, an unmanipulated image. How did photographer Randy Olson do it? "I went out in a boat on the Yellow River when it was still dark," Randy explains. "Just at dawn, one shaft of morning light shone through the trees that were blocking the rest of the sun. The light was seen first above the croc's nose, then down the length of its nose, until it hit directly in its mouth."

Does it really matter if a person is killed by a crude bomb or a professional soldier? Murder is murder regardless of what we choose to call the murderer.

Behind the Scenes

Let me get this straight. Marine Corps Staff Sgt. Jerome Boganowski was sent to Iraq to direct convoys to military bases. He had to bring a NATIONAL GEOGRAPHIC map of the Middle East and his own global positioning system "from home"! Bravo to you for inadvertently serving a lifesaving function and to Sergeant Boganowski for improvising. Shame on those responsible for placing a dedicated volunteer in such a dire situation. And I thought that I was being clever by using your maps and other supplements in my classroom.

ANTHONY ADAMCZYK
Manchester, Connecticut

Geographica: A Vote for Democracy

While the U.S. may have been "the first modern democracy," eventually enfranchising women and African Americans, it has also become one of the most restrictive democracies among modern nations. By a combination of unequal ballot-access laws, exclusionary criteria for the inclusion of independent candidates in debates, and other practices, the Democratic and Republican Parties have combined to suppress third-party and independent candidates to the point of virtual nonexistence.

OMAR H. ALI
Towson, Maryland

ZipUSA: Kelly, Wyoming







It was a pleasure to read your article on the Teton Science Schools. As a grade-schooler, I had the opportunity to attend a program there that I will never forget. I remember examining the bird specimens in the Murie Museum, going on night hikes to view the stars, and venturing out to hear the elk bugle in the early morning. I was exposed not only to how glorious our Earth is but also to how to protect it. In one simple lesson an instructor showed us how much water we waste when we leave the faucet on while we brush our teeth. That demonstration still influences the way I brush!

CHELSEA DYRENG
Chapel Hill, North Carolina

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INDICATIONS AND USAGE Seasonal Allergic Rhinitis ALLEGRA is indicated for the relief of symptoms associated with seasonal allergic rhinitis in adults and children 6 years of age and older. Symptoms treated effectively were sneezing, rhinorrhea, itchy nose/palate/throat, itchy/watery/red eyes. **Chronic Idiopathic Urticaria** ALLEGRA is indicated for treatment of uncomplicated skin manifestations of chronic idiopathic urticaria in adults and children 6 years of age and older. It significantly reduces pruritus and the number of wheals. **CONTRAINDICATIONS** ALLEGRA is contraindicated in patients with known hypersensitivity to any of its ingredients. **PRECAUTIONS Drug Interaction with Erythromycin and Ketoconazole** Fexofenadine hydrochloride has been shown to exhibit minimal (ca. 5%) metabolism. However, co-administration of fexofenadine hydrochloride with ketoconazole and erythromycin led to increased plasma levels of fexofenadine hydrochloride. Fexofenadine hydrochloride had no effect on the pharmacokinetics of erythromycin and ketoconazole. In two separate studies, fexofenadine hydrochloride 120 mg twice daily (two times the recommended twice daily dose) was co-administered with erythromycin 500 mg every 8 hours or ketoconazole 400 mg once daily under steady state conditions to normal, healthy volunteers (n=24, each study). No differences in adverse events or QT_c interval were observed when patients were administered fexofenadine hydrochloride alone or in combination with erythromycin or ketoconazole. The findings of these studies are summarized in the following table:

Effects on steady-state fexofenadine hydrochloride pharmacokinetics after 7 days of co-administration with fexofenadine hydrochloride 120 mg every 12 hours (two times the recommended twice daily dose) in normal volunteers (n=24)

Concomitant Drug	C _{max,SS} (Peak plasma concentration)	AUC _{0-12h} (Extent of systemic exposure)
Erythromycin (500 mg every 8 hrs)	+82%	+109%
Ketoconazole (400 mg once daily)	+135%	+164%

The changes in plasma levels were within the range of plasma levels achieved in adequate and well-controlled clinical trials. The mechanism of these interactions has been evaluated in *in vitro*, *in situ*, and *in vivo* animal models. These studies indicate that ketoconazole or erythromycin co-administration enhances fexofenadine gastrointestinal absorption. *In vivo* animal studies also suggest that in addition to increasing absorption, ketoconazole decreases fexofenadine hydrochloride gastrointestinal secretion, while erythromycin may also decrease biliary excretion. **Drug Interactions with Antacids** Administration of 120 mg of fexofenadine hydrochloride (2 x 60 mg capsules) within 15 minutes of an aluminum and magnesium containing antacid (Maalox®) decreased fexofenadine AUC by 41% and C_{max} by 43%. ALLEGRA should not be taken closely in time with aluminum and magnesium containing antacids. **Carcinogenesis, Mutagenesis, Impairment of Fertility** The carcinogenic potential and reproductive toxicity of fexofenadine hydrochloride were assessed using terfenadine studies with adequate fexofenadine hydrochloride exposure (based on plasma area-under-the-concentration vs. time [AUC] values). No evidence of carcinogenicity was observed in an 18-month study in mice and in a 24-month study in rats at oral doses up to 150 mg/kg of terfenadine (which led to fexofenadine exposures that were respectively approximately 3 and 5 times the exposure from the maximum recommended daily oral dose of fexofenadine hydrochloride in adults and children). *In vitro* (Bacterial Reverse Mutation, CHO/HGPRT Forward Mutation, and Rat Lymphocyte Chromosomal Aberration assays) and *in vivo* (Mouse Bone Marrow Micronucleus assay) tests, fexofenadine hydrochloride revealed no evidence of mutagenicity. In rat fertility studies, dose-related reductions in implants and increases in postimplantation losses were observed at an oral dose of 150 mg/kg of terfenadine (which led to fexofenadine hydrochloride exposures that were approximately 3 times the exposure of the maximum recommended daily oral dose of fexofenadine hydrochloride in adults). **Pregnancy Teratogenic Effects: Category C.** There was no evidence of teratogenicity in rats or rabbits at oral doses of terfenadine up to 300 mg/kg (which led to fexofenadine exposures that were approximately 4 and 31 times, respectively, the exposure from the maximum recommended daily oral dose of fexofenadine in adults). There are no adequate and well controlled studies in pregnant women. Fexofenadine should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus. **Nonteratogenic Effects.** Dose-related decreases in pup weight gain and survival were observed in rats exposed to an oral dose of 150 mg/kg of terfenadine (approximately 3 times the maximum recommended daily oral dose of fexofenadine hydrochloride in adults based on comparison of fexofenadine hydrochloride AUCs). **Nursing Mothers** There are no adequate and well-controlled studies in women during lactation. Because many drugs are excreted in human milk, caution should be exercised when fexofenadine hydrochloride is administered to a nursing woman. **Pediatric Use** The recommended dose in patients 6 to 11 years of age is based on cross-study comparison of the pharmacokinetics of ALLEGRA in adults and pediatric patients and on the safety profile of fexofenadine hydrochloride in both adult and pediatric patients at doses equal to or higher than the recommended doses. The safety of ALLEGRA tablets at a dose of 30 mg twice daily has been demonstrated in 438 pediatric patients 6 to 11 years of age in two placebo-controlled 2-week seasonal allergic rhinitis trials. The safety of ALLEGRA for the treatment of chronic idiopathic urticaria in patients 6 to 11 years of age is based on cross-study comparison of the pharmacokinetics of ALLEGRA in adult and pediatric patients and on the safety profile of fexofenadine in both adult and pediatric patients at doses equal to or higher than the recommended dose. The effectiveness of ALLEGRA for the treatment of seasonal allergic rhinitis in patients 6 to 11 years of age was demonstrated in one trial (n=411) in which ALLEGRA tablets 30 mg twice daily significantly reduced total symptom scores compared to placebo, along with extrapolation of demonstrated efficacy in patients ages 12 years and above, and the pharmacokinetic comparisons in adults and children. The effectiveness of ALLEGRA for the treatment of chronic idiopathic urticaria in patients 6 to 11 years of age is based on an extrapolation of the demonstrated efficacy of ALLEGRA in adults with this condition and the likelihood that the disease course, pathophysiology and the drug's effect are substantially similar in children to that of adult patients. Three clinical safety studies comparing 15 mg BID (n=85) and 30 mg BID (n=330) of an experimental formulation of fexofenadine to placebo (n=430) have been conducted in pediatric patients aged 6 months to 5 years. In general, fexofenadine hydrochloride was well tolerated in these studies. No unexpected adverse events were seen given the known safety profile of fexofenadine and likely adverse reactions for this patient population. (See ADVERSE REACTIONS and CLINICAL PHARMACOLOGY.) The safety and effectiveness of fexofenadine hydrochloride in pediatric patients under 6 years of age have not been established. **Geriatric Use** Clinical studies of ALLEGRA tablets and capsules did not include sufficient numbers of subjects aged 65 years and over to determine whether this population responds differently from younger patients. Other reported clinical experience has not identified differences in responses between the geriatric and younger patients. This drug is known to be substantially excreted by the kidney, and the risk of toxic reactions to this drug may be greater in patients with impaired renal function. Because elderly patients are more likely to have decreased renal function, care should be taken in dose selection, and may be useful to monitor renal function. (See CLINICAL PHARMACOLOGY.) **ADVERSE REACTIONS Seasonal Allergic Rhinitis Adults.** In placebo-controlled seasonal allergic rhinitis clinical trials in patients 12 years of age and older, which included 2461 patients receiving fexofenadine hydrochloride capsules at doses of 20 mg to 240 mg twice daily, adverse events were similar in fexofenadine hydrochloride and placebo-treated patients. All adverse events that were reported by greater than 1% of patients who received the recommended daily dose of fexofenadine hydrochloride (60 mg capsules twice daily), and that were more common with fexofenadine hydrochloride than placebo, are listed in Table 1. In a placebo-controlled clinical study in the United States, which included 570 patients aged 12 years and older receiving fexofenadine hydrochloride tablets at doses of 120 or 180 mg once daily, adverse events were similar in fexofenadine hydrochloride and placebo-treated patients. Table 1 also lists adverse experiences that were reported by greater than 2% of patients treated with fexofenadine hydrochloride tablets at doses of 180 mg once daily and that were more common with fexofenadine hydrochloride than placebo. The incidence of adverse events, including drowsiness, was not dose-related and was similar across subgroups defined by age, gender, and race.

Table 1
Adverse experiences in patients ages 12 years and older reported in placebo-controlled allergic rhinitis clinical trials in the United States

Adverse experience	Twice daily dosing with fexofenadine capsules at rates of greater than 1%	
	Fexofenadine 60 mg Twice Daily (n=679)	Placebo Twice Daily (n=671)
Viral Infection (cold, flu)	2.5%	1.5%
Nausea	1.6%	1.5%
Dysmenorrhea	1.5%	0.3%
Drowsiness	1.3%	0.9%
Dyspepsia	1.3%	0.6%
Fatigue	1.3%	0.9%

Once daily dosing with fexofenadine hydrochloride tablets at rates of greater than 2%

Adverse experience	Fexofenadine 180 mg once daily (n=283)		Placebo (n=293)
	Headache	10.6%	
Upper Respiratory Tract Infection	3.2%	3.1%	
Back Pain	2.8%	1.4%	

The frequency and magnitude of laboratory abnormalities were similar in fexofenadine hydrochloride and placebo-treated patients. **Pediatric.** Table 2 lists adverse experiences in patients aged 6 to 11 years of age which were reported by greater than 2% of patients treated with fexofenadine hydrochloride tablets at a dose of 30 mg twice daily in placebo-controlled seasonal allergic rhinitis studies in the United States and Canada that were more common with fexofenadine hydrochloride than placebo.

Table 2
Adverse experiences reported in placebo-controlled seasonal allergic rhinitis studies in pediatric patients ages 6 to 11 in the United States and Canada at rates of greater than 2%

Adverse experience	Fexofenadine 30 mg twice daily (n=209)		Placebo (n=229)
	Headache	7.2%	
Accidental Injury	2.9%	1.3%	
Coughing	3.8%	1.3%	
Fever	2.4%	0.9%	
Pain	2.4%	0.4%	
Otitis Media	2.4%	0.0%	
Upper Respiratory Tract Infection	4.3%	1.7%	

Three clinical safety studies in 845 children aged 6 months to 5 years comparing 15 mg BID (n=85) and 30 mg BID (n=330) of an experimental formulation of fexofenadine to placebo (n=430) have been conducted. In general, fexofenadine hydrochloride was well tolerated in these studies. No unexpected adverse events were seen given the known safety profile of fexofenadine and likely adverse reactions for this patient population. (See PRECAUTIONS Pediatric Use.) **Chronic Idiopathic Urticaria** Adverse events reported by patients 12 years of age and older in placebo-controlled chronic idiopathic urticaria studies were similar to those reported in placebo-controlled seasonal allergic rhinitis studies. In placebo-controlled chronic idiopathic urticaria clinical trials, which included 726 patients 12 years of age and older receiving fexofenadine hydrochloride tablets at doses of 20 to 240 mg twice daily, adverse events were similar in fexofenadine hydrochloride and placebo-treated patients. Table 3 lists adverse experiences in patients aged 12 years and older which were reported by greater than 2% of patients treated with fexofenadine hydrochloride 60 mg tablets twice daily in controlled clinical studies in the United States and Canada and that were more common with fexofenadine hydrochloride than placebo. The safety of fexofenadine hydrochloride in the treatment of chronic idiopathic urticaria in pediatric patients 6 to 11 years of age is based on the safety profile of fexofenadine hydrochloride in adults and adolescent patients at doses equal to or higher than the recommended dose (see Pediatric Use).

Table 3
Adverse experiences reported in patients 12 years and older in placebo-controlled chronic idiopathic urticaria studies in the United States and Canada at rates of greater than 2%

Adverse experience	Fexofenadine 60 mg twice daily (n=186)		Placebo (n=178)
	Back Pain	2.2%	
Sinusitis	2.2%	1.1%	
Dizziness	2.2%	0.6%	
Drowsiness	2.2%	0.0%	

Events that have been reported during controlled clinical trials involving seasonal allergic rhinitis and chronic idiopathic urticaria patients with incidences less than 1% and similar to placebo and have been rarely reported during postmarketing surveillance include: insomnia, nervousness, and sleep disorders or paroniria. In rare cases, rash, urticaria, pruritus and hypersensitivity reactions with manifestations such as angioedema, chest tightness, dyspnea, flushing and systemic anaphylaxis have been reported. **OVERDOSAGE** Reports of fexofenadine hydrochloride overdose have been infrequent and contain limited information. However, dizziness, drowsiness, and dry mouth have been reported. Single doses of fexofenadine hydrochloride up to 800 mg (six normal volunteers at this dose level), and doses up to 690 mg twice daily for 1 month (three normal volunteers at this dose level) or 240 mg once daily for 1 year (234 normal volunteers at this dose level) were administered without the development of clinically significant adverse events as compared to placebo. In the event of overdose, consider standard measures to remove any unabsorbed drug. Symptomatic and supportive treatment is recommended. Hemodialysis did not effectively remove fexofenadine hydrochloride from blood (1.7% removed) following terfenadine administration. No deaths occurred at oral doses of fexofenadine hydrochloride up to 5000 mg/kg in mice (110 times the maximum recommended daily oral dose in adults and 200 times the maximum recommended daily oral dose in children based on mg/m²) and up to 5000 mg/kg in rats (230 times the maximum recommended daily oral dose in adults and 400 times the maximum recommended daily oral dose in children based on mg/m²). Additionally, no clinical signs of toxicity or gross pathological findings were observed. In dogs, no evidence of toxicity was observed at oral doses up to 2000 mg/kg (300 times the maximum recommended daily oral dose in adults and 530 times the maximum recommended daily oral dose in children based on mg/m²). **DOSAGE AND ADMINISTRATION Seasonal Allergic Rhinitis Adults and Children 12 Years and Older.** The recommended dose of ALLEGRA is 60 mg twice daily, or 180 mg once daily. A dose of 60 mg once daily is recommended as the starting dose in patients with decreased renal function (see CLINICAL PHARMACOLOGY). **Children 6 to 11 Years.** The recommended dose of ALLEGRA is 30 mg twice daily. A dose of 30 mg once daily is recommended as the starting dose in pediatric patients with decreased renal function (see CLINICAL PHARMACOLOGY). **Chronic Idiopathic Urticaria Adults and Children 12 Years and Older.** The recommended dose of ALLEGRA is 60 mg twice daily. A dose of 60 mg once daily is recommended as the starting dose in patients with decreased renal function (see CLINICAL PHARMACOLOGY). **Children 6 to 11 Years.** The recommended dose of ALLEGRA is 30 mg twice daily. A dose of 30 mg once daily is recommended as the starting dose in pediatric patients with decreased renal function (see CLINICAL PHARMACOLOGY). Please see product circular for full prescribing information.

Rx only

Rev. May 2003a

Brief Summary

Aventis Pharmaceuticals Inc.

Kansas City, MO 64137 USA

US Patents 4,254,129; 5,375,693; 5,578,610

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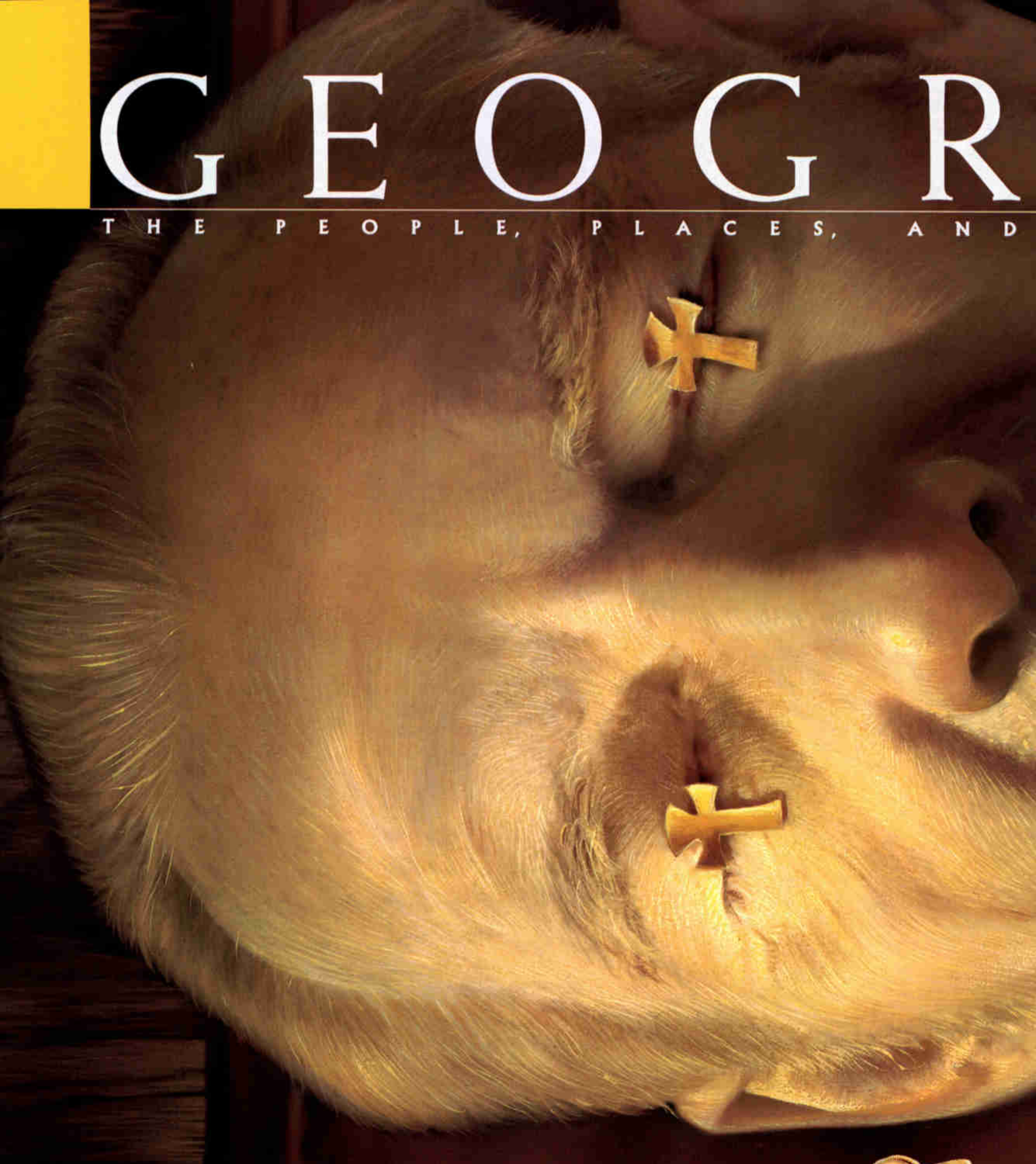


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ARCHAEOLOGY

Crossing Over

A Saxon tomb set for a Christian king

A bit of tooth is all that remains of the man, but his well-preserved seventh-century grave at Prittlewell in Essex, England, suggests that the interred may have been

Saeberht, the first East Saxon king to convert to Christianity (artist rendering above).

"He's the only obvious candidate," says Ian Blair, senior archaeologist of the Museum

of London Archaeology Service and the excavation's director. "We'll probably never know for sure, but it's tempting to suggest he's our man."



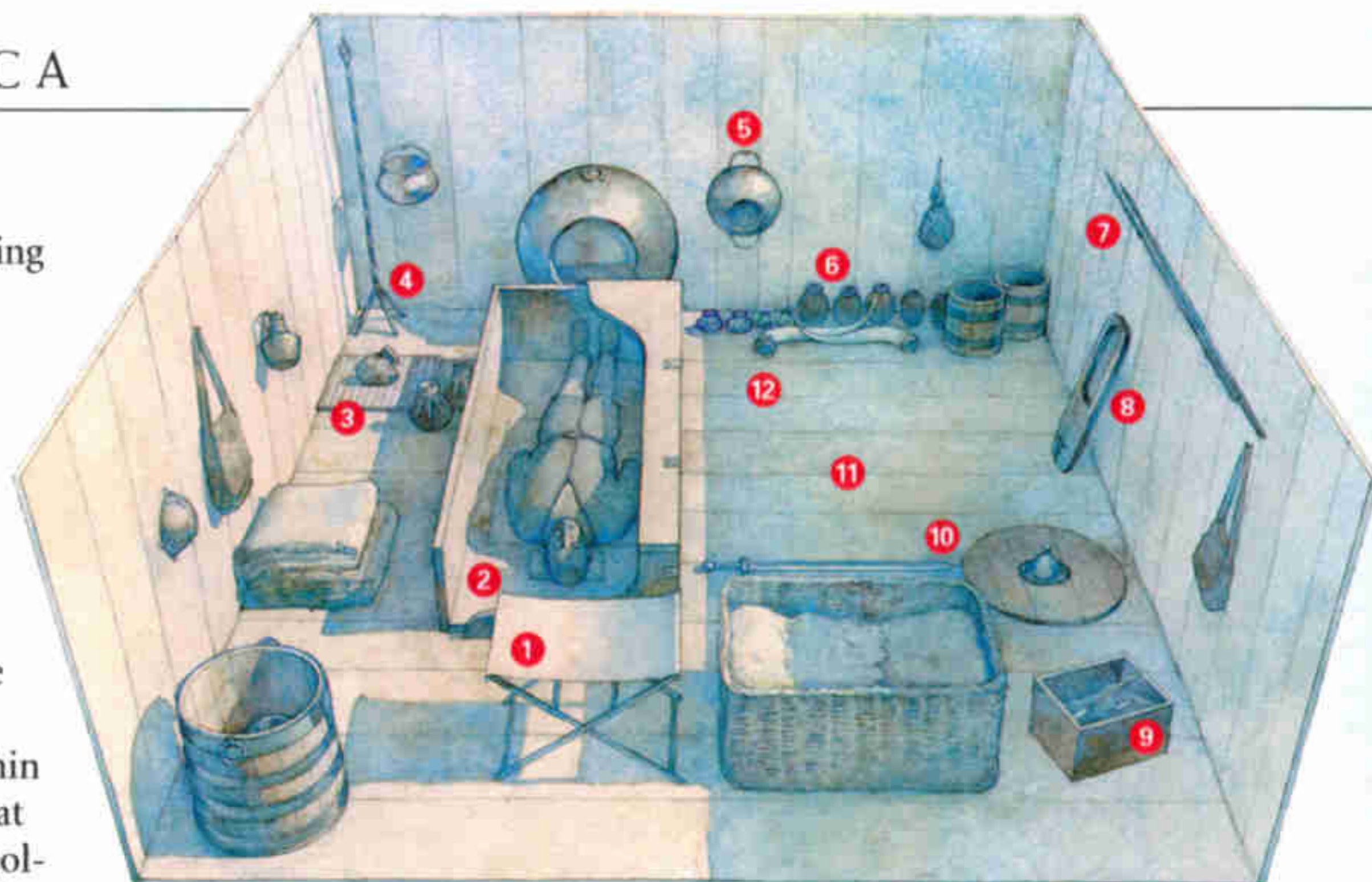
APHICA

CREATURES OF OUR UNIVERSE



The tomb, unearthed during a routine archaeological evaluation prior to road construction, was likely preserved as dirt and sand sifted through its roof timbers over time. “The chamber was intact and undisturbed, with items still on the walls where they were hung 1,400 years ago,” says Blair. Objects within the burial room indicate that the deceased, whom archaeologists dubbed the Prince of Prittlewell, was a contemporary of a pagan king buried about 45 miles northeast at Sutton Hoo. (Excavated in 1939, Sutton Hoo remains the most elaborate Anglo-Saxon tomb complex ever found.)

During the seventh century A.D. much of Britain was divided into small kingdoms, and Christian missionaries sent from Rome were converting the rulers of these kingdoms with some success. The Prittlewell artifacts suggest a royal who straddled the two worlds, pagan and Christian, carrying elements from both to the grave. While most of the goods conjure the chest-thumping, mead-swilling life celebrated in the epic poem *Beowulf*—



ART BY GREG HARLIN

- 1 Portable iron folding stool
- 2 Traces of wooden coffin and gold effects
- 3 57 bone gaming pieces (board is assumed)
- 4 Iron stand, possibly for banner or candles
- 5 Eastern Mediterranean bronze bowl
- 6 Gilded drinking vessels
- 7 Two iron spears
- 8 Remains of wooden lyre
- 9 Inscribed silver spoon inside wooden box
- 10 Iron sword and parts of iron/wood shield
- 11 Fragments of animal teeth
- 12 Drinking horns with copper and gold rims

a lyre, gaming pieces, and drinking horns, plus hints of wealth in gold coins and a belt buckle (previous page)—this Saxon was also equipped for a Christian death. A cross etched into a silver spoon, a flagon embossed with a figure resembling a saint, and a pair of gold-foil crosses point to a Christian conversion.

Bolstering the theory that the convert was King Saeberht of Essex are native crafts such as blown-glass jars (below) identical to jars found at other Saxon graves, including Sutton Hoo. Exotic



items like the French coins, eastern Mediterranean bowl and flagon, and iron folding stool from Italy or Asia Minor may have been gifts from one notable to another.

Artifact conservation is currently under way, and traces of textiles and wood have already been found in the sands that for centuries kept the tomb intact. Says Blair, “You can never completely predict what may lie buried beneath your feet.”

—Jennifer S. Holland

Other Grave Sites

Headless skeletons Thirteen 3,000-year-old headless skeletons of the pre-Polynesian Lapita people found on Vanuatu.

Tiny hominins Remains of seven diminutive bodies, including that of a three-foot-tall, 18,000-year-old female, found in Indonesia.

Earliest Californian 13,000-year-old remains of a woman uncovered on Santa Rosa Island.

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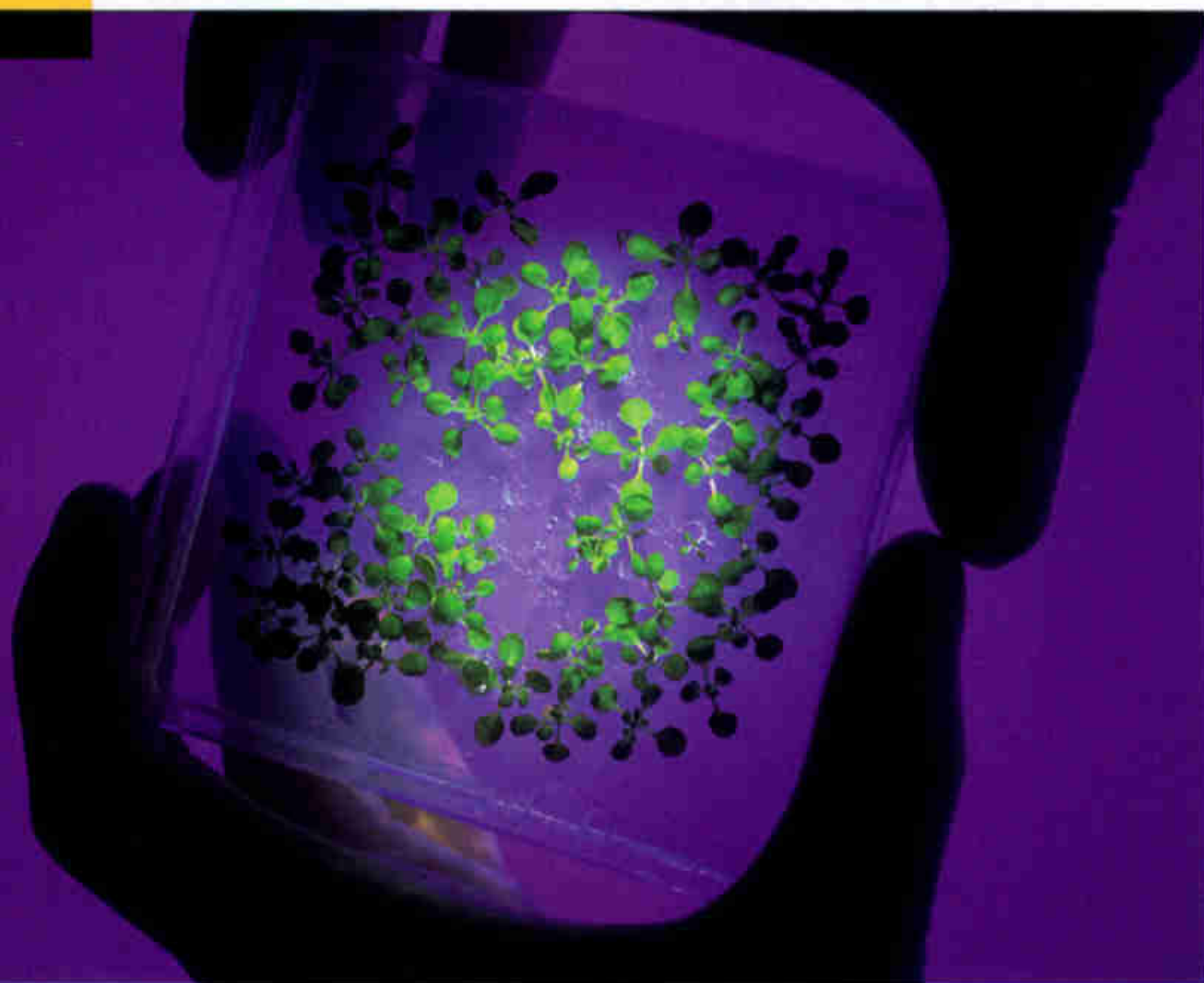


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STEVE TAYLOR, SCIENCE PHOTO LIBRARY; HENRIK FREEK (BELOW)

BOTANY

Weeding Out Land Mines

Gene-altered plant blushes when roots sense explosives

A lethal problem just might be solved with a leafy approach: using genetically modified plants to find land mines. Scientists at the Danish firm Aresa Biodetection and the University of Copenhagen have produced a variety of thale cress (*Arabidopsis thaliana*, above) that turns from green to red (below) when its roots encounter nitrogen dioxide—a by-product of land mines that gradually evaporates from buried explosives.

Thale cress naturally changes color under certain conditions, says Aresa's founder Carsten Meier. "We manipulated the plant's genetic switch so that this variety changes color when it senses nitrogen dioxide." A range of experiments have been performed with thale cress, including growing it in soil laced with a TNT solution and in boxes containing land mines. Soon Meier hopes to test the plant on live mines in Bosnia.

"It's an interesting idea," says

land mine expert Bill Reid, who still notes several drawbacks, among them the costs of defoliating minefields before sowing the plants, and watering in arid climates. But Meier thinks further research may yield strains able to overcome such challenges.

Scientists have tried many techniques to locate the world's estimated 60 million land mines, from training rats to sniff out explosives to using honeybees to collect chemical samples. As yet, says Reid, "there is no silver bullet." —Peter Gwin



GEO NEWS

ASTRONOMY

■ **Scientists have proposed the creation of planetary parks on Mars.** Concerns over debris left by unmanned exploration vehicles prompted the idea. Seven areas of the red planet representing features including mountains, meteorite craters, a polar ice cap, and the solar system's largest volcano have been suggested for possible conservation.

GENETICS

■ **Humans have fewer protein-coding genes than once thought,** according to a new study of the human genome. The revised count—which scientists say should serve as a reference for decades to come—numbers 20,000 to 25,000 genes; a previous estimate was 40,000.

ANIMAL KINGDOM

■ **A bird thought extinct was sighted in Mexico.** Though about 10,000 Cozumel thrashers once lived on Cozumel Island off the Yucatán Peninsula, none had been seen in nearly a decade. The introduction of boa constrictors to the island in 1971 may have contributed to the decline. Biologists searching for the bird during a recent expedition spotted just one Cozumel thrasher. The species is now among Mexico's most endangered.

POLLUTION

■ **The air in southern California last year was the cleanest** since such records of the region's air quality have been kept, say officials. Even so, its air pollution levels are still among the highest in the U.S.

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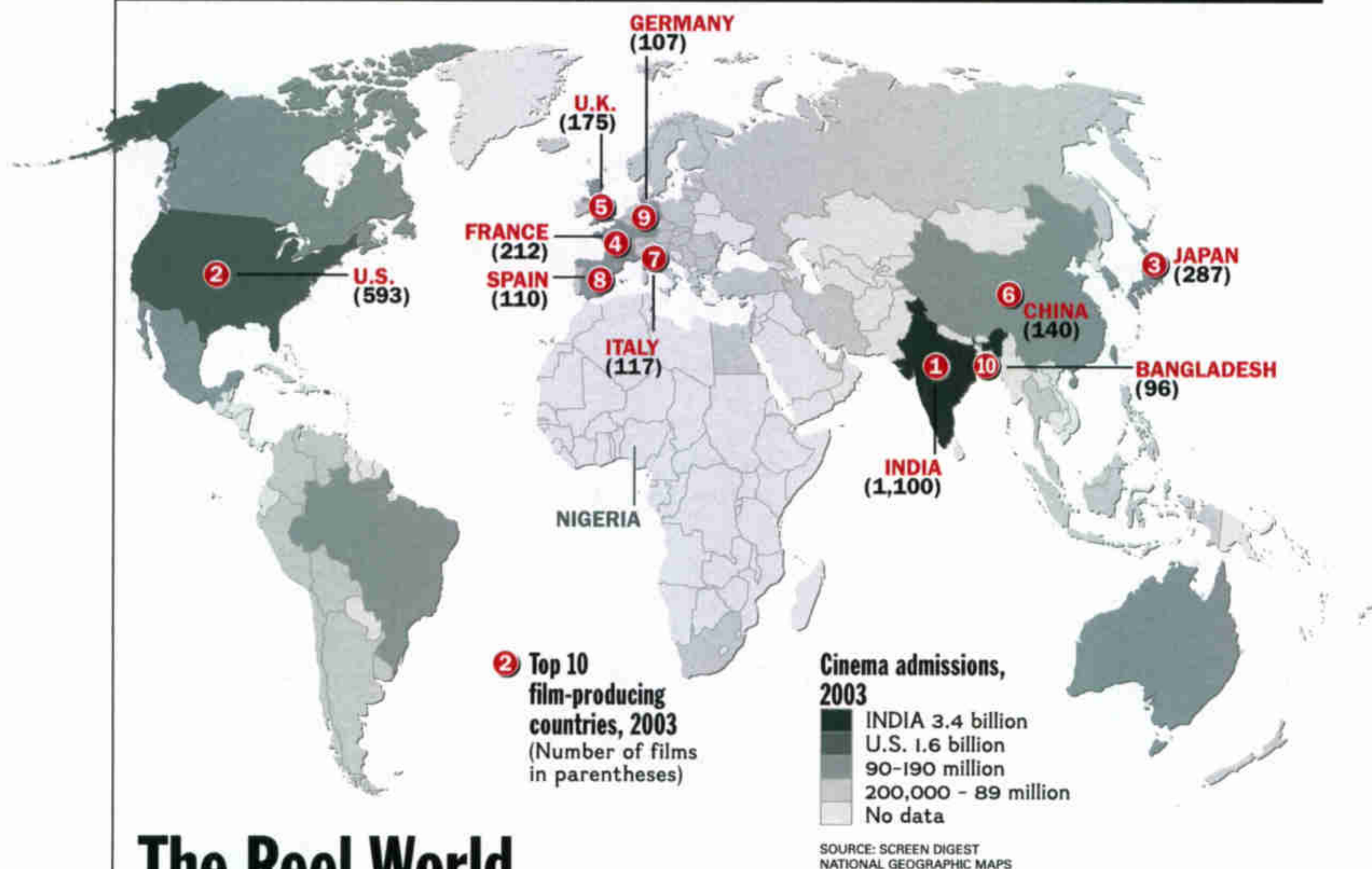
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The Reel World

Nigerians don't go to the movies; the movies come to them. With few operating cinemas in Nigeria's largest city of Lagos, screenings often occur in local restaurants and private homes; videos are sold at market stands and sometimes hawked to motorists caught in traffic. This distribution of films from "Nollywood," as the country's ultralow-budget industry is known, may seem unusual,



NGS PHOTOGRAPHER WILLIAM ALBERT ALLARD

but it still satisfies the demand for movies—an obsession shared by people around the world.

In 2003, according to film industry source *Screen Digest*, some seven billion movie tickets were sold worldwide, earning an estimated 22 billion dollars. The greatest share of these global box-office receipts—more than 43 percent—came from U.S. theaters. Japanese theaters charged the most for tickets: Reserved seats can cost up to \$25. Though India made more films than Hollywood, it made less money from them; the price of admission to an Indian theater (left) averaged just 20 cents.

Many American blockbusters rake in more money internationally than at home. *Titanic*, the highest grossing film of all time, made two-thirds of its 1.8-billion-dollar take overseas. American

movies have long been retooled for foreign sale. In the 1930s stars such as the comedy team Laurel and Hardy reshot their films in German and other languages—coached with phonetically spelled cue cards. Now native speakers are recorded over original actors' voices with varying success. In the French version of *Star Wars*, the villain's voice is considerably less menacing, and his name's been changed to Dark Vador.

American movies may be popular abroad, but foreign concession stands still cater to local tastes. Some European audiences wash their popcorn down with beer. In China the popcorn's sweetened. Other film snack favorites there—spicy cabbage, salted plums, dried squid shreds—have a flavor all their own.

—Scott Elder



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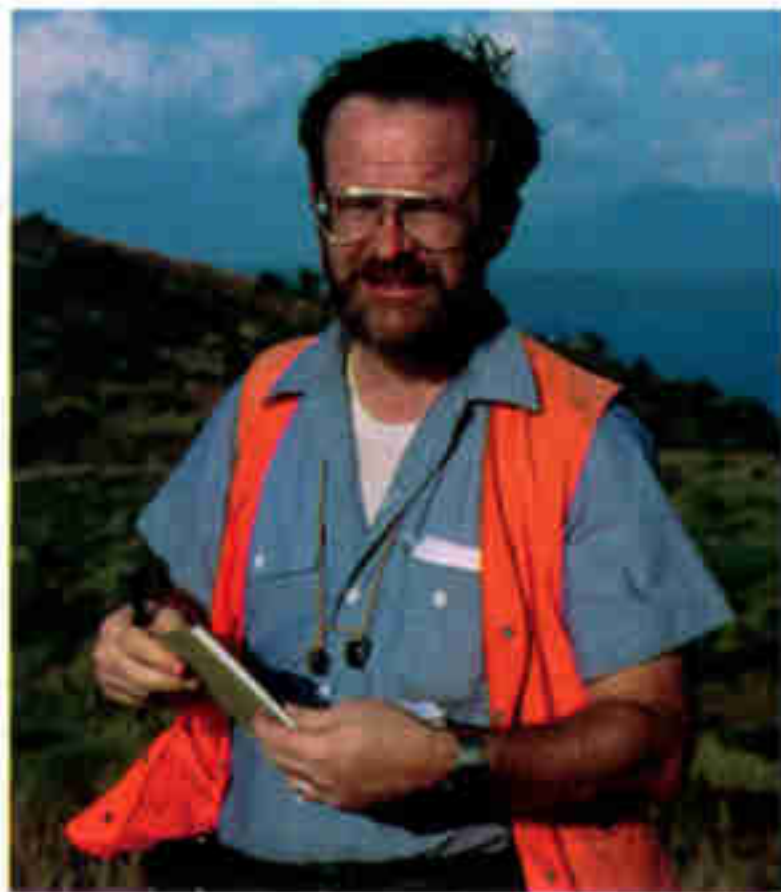
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My Seven



How to Know When It's Going to Blow

Chris Newhall *Volcanologist*

In observation of the restless Earth, Chris Newhall—a USGS geologist at the University of Washington—has been restless himself, studying volcanoes all over the world. All volcanoes have quirks, he notes, but they have predictability too. Here are some signs (in their usual order of appearance) nature sends to say that an eruption may be on the way.

1 Gas leaks
Magma rising deep beneath the volcano releases carbon dioxide, which can be measured at a volcano's fumaroles (right, at Mount Pinatubo in the Philippines) or as it diffuses through the soil on the volcano's slopes.

2 Bit of a bulge
A slight swelling over a broad area of the volcano's surface may indicate the pressurization of magma lurking several miles below. This is best seen using satellite-based radar interferometry.

3 Getting shaky
Hundreds of small earthquakes rumbling underfoot may mean molten rock is forcing its way up through the crust—or that pressurized volcanic fluids are escaping through cracks deep under the surface. **Constant ground vibration** may also occur.

4 Dropping fast
A sudden decrease in these small quakes (sometimes with a drop in sulfur dioxide gas emission) can mean magma has stalled at or just beneath the ground surface. These quick decreases don't always happen, but if and when they do, watch out!

5 Big bump
A pronounced bulge within a few hundred yards of a volcano's

vent indicates influx or magma pressurization close to the surface.

6 Blowing off steam
Explosions of steam happen when rising magma and gases heat, and pressurize, trapped pockets of groundwater. After these powerful explosions pulverize preexisting rocks into ash and pierce the plug of overlying rock, then strong, continuous steam jets can persist for days or even months.

7 And finally . . .
Volcanologists like to say that there's one sure way to know when a volcano is ready to erupt: It will always happen whenever you take a rest from hours of watching it, or when you decide that it's never going to blow.

ROGER RESSMEYER, CORBIS (BOTH)





There's a different way to treat seasonal allergies.

SINGULAIR IS THE ONLY SEASONAL ALLERGY MEDICATION THAT SPECIFICALLY BLOCKS LEUKOTRIENES. Many existing allergy medicines block histamine. SINGULAIR is different. It works by blocking leukotrienes (loo-koh-TRY-eens). Leukotrienes are an underlying cause of allergy symptoms. They are substances produced in your body that can make you feel uncomfortable during allergy season.

HELPS RELIEVE A BROAD RANGE OF SYMPTOMS. A single SINGULAIR tablet a day helps relieve a broad range of seasonal allergy symptoms for a full 24 hours. SINGULAIR is also available in a cherry chewable tablet for children 2 to 14 years of age. In clinical studies, SINGULAIR was not associated with drowsiness. SINGULAIR should be taken once a day, as prescribed. SINGULAIR is available by prescription only.

IMPORTANT INFORMATION: In clinical studies, side effects were usually mild and varied by age, and included headache, ear infection, sore throat, and upper respiratory infection. Side effects generally did not stop patients from taking SINGULAIR. SINGULAIR should not be taken by people who are sensitive to any of its ingredients.

Ask your doctor about SINGULAIR for your seasonal allergies.
Call 1-888-MERCK-95, or visit singulair.com.

Please see the Patient Product Information on the adjacent page and discuss it with your doctor.



This product is available through the Merck Patient Assistance Program. To find out if you qualify call 1-888-MERCK-56.

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Patient Information
SINGULAIR® (SING-u-lair) Tablets, Chewable Tablets, and Oral Granules
Generic name: montelukast (mon-te-LOO-kast) sodium

9094217

Read this information before you start taking SINGULAIR®. Also, read the leaflet you get each time you refill SINGULAIR, since there may be new information in the leaflet since the last time you saw it. This leaflet does not take the place of talking with your doctor about your medical condition and/or your treatment.

What is SINGULAIR®?

- SINGULAIR is a medicine called a leukotriene receptor antagonist. It works by blocking substances in the body called leukotrienes. Blocking leukotrienes improves asthma and seasonal allergic rhinitis (also known as hay fever). SINGULAIR is not a steroid.

SINGULAIR is prescribed for the treatment of asthma and seasonal allergic rhinitis:

1. Asthma.

SINGULAIR should be used for the long-term management of asthma in adults and children ages 12 months and older.

Do not take SINGULAIR for the immediate relief of an asthma attack. If you get an asthma attack, you should follow the instructions your doctor gave you for treating asthma attacks. (See the end of this leaflet for more information about asthma.)

2. Seasonal Allergic Rhinitis.

SINGULAIR is used to help control the symptoms of seasonal allergic rhinitis (sneezing, stuffy nose, runny nose, itching of the nose) in adults and children ages 2 years and older. (See the end of this leaflet for more information about seasonal allergic rhinitis.)

Who should not take SINGULAIR?

Do not take SINGULAIR if you are allergic to SINGULAIR or any of its ingredients.

The active ingredient in SINGULAIR is montelukast sodium.

See the end of this leaflet for a list of all the ingredients in SINGULAIR.

What should I tell my doctor before I start taking SINGULAIR?

Tell your doctor about:

- **Pregnancy:** If you are pregnant or plan to become pregnant, SINGULAIR may not be right for you.
- **Breast-feeding:** If you are breast-feeding, SINGULAIR may be passed in your milk to your baby. You should consult your doctor before taking SINGULAIR if you are breast-feeding or intend to breast-feed.
- **Medical Problems or Allergies:** Talk about any medical problems or allergies you have now or had in the past.
- **Other Medicines:** Tell your doctor about all the medicines you take, including prescription and non-prescription medicines, and herbal supplements. Some medicines may affect how SINGULAIR works, or SINGULAIR may affect how your other medicines work.

How should I take SINGULAIR?

For adults or children 12 months of age and older with asthma:

- Take SINGULAIR once a day in the evening.
- Take SINGULAIR every day for as long as your doctor prescribes it, even if you have no asthma symptoms.
- You may take SINGULAIR with food or without food.
- If your asthma symptoms get worse, or if you need to increase the use of your inhaled rescue medicine for asthma attacks, call your doctor right away.
- **Do not take SINGULAIR for the immediate relief of an asthma attack.** If you get an asthma attack, you should follow the instructions your doctor gave you for treating asthma attacks.
- Always have your inhaled rescue medicine for asthma attacks with you.
- Do not stop taking or lower the dose of your other asthma medicines unless your doctor tells you to.
- If your doctor has prescribed a medicine for you to use before exercise, keep using that medicine unless your doctor tells you not to.

For adults and children 2 years of age and older with seasonal allergic rhinitis:

- Take SINGULAIR once a day, at about the same time each day.

- Take SINGULAIR every day for as long as your doctor prescribes it.
- You may take SINGULAIR with food or without food.

How should I give SINGULAIR oral granules to my child?

Do not open the packet until ready to use.

SINGULAIR 4-mg oral granules can be given either:

- directly in the mouth;
- OR
- mixed with a spoonful of one of the following soft foods at cold or room temperature: apple-sauce, mashed carrots, rice, or ice cream. Be sure that the entire dose is mixed with the food and that the child is given the entire spoonful of the mixture right away (within 15 minutes).

IMPORTANT: Never store any oral granule/food mixture for use at a later time. Throw away any unused portion.

Do not put SINGULAIR oral granules in liquid drink. However, your child may drink liquids after swallowing the SINGULAIR oral granules.

What is the daily dose of SINGULAIR for asthma or seasonal allergic rhinitis?

For Asthma (Take in the evening):

- One 10-mg tablet for adults and adolescents 15 years of age and older,
- One 5-mg chewable tablet for children 6 to 14 years of age,
- One 4-mg chewable tablet or one packet of 4-mg oral granules for children 2 to 5 years of age, or
- One packet of 4-mg oral granules for children 12 to 23 months of age.

For Seasonal Allergic Rhinitis (Take at about the same time each day):

- One 10-mg tablet for adults and adolescents 15 years of age and older,
- One 5-mg chewable tablet for children 6 to 14 years of age, or
- One 4-mg chewable tablet or one packet of 4-mg oral granules for children 2 to 5 years of age.

What should I avoid while taking SINGULAIR?

If you have asthma and if your asthma is made worse by aspirin, continue to avoid aspirin or other medicines called non-steroidal anti-inflammatory drugs while taking SINGULAIR.

What are the possible side effects of SINGULAIR?

The side effects of SINGULAIR are usually mild, and generally did not cause patients to stop taking their medicine. The side effects in patients treated with SINGULAIR were similar in type and frequency to side effects in patients who were given a placebo (a pill containing no medicine).

The most common side effects with SINGULAIR include:

- stomach pain
- stomach or intestinal upset
- heartburn
- tiredness
- fever
- stuffy nose
- cough
- flu
- upper respiratory infection
- dizziness
- headache
- rash

Less common side effects that have happened with SINGULAIR include (listed alphabetically): agitation including aggressive behavior, allergic reactions (including swelling of the face, lips, tongue, and/or throat, which may cause trouble breathing or swallowing), hives, and itching, bad/vivid dreams, increased bleeding tendency, bruising, diarrhea, drowsiness, hallucinations (seeing things that are not there), hepatitis, indigestion, inflammation of the pancreas, irritability, joint pain, muscle aches and muscle cramps, nausea, palpitations, pins and needles/numbness, restlessness, seizures (convulsions or fits), swelling, trouble sleeping, and vomiting.

Rarely, asthmatic patients taking SINGULAIR have

experienced a condition that includes certain symptoms that do not go away or that get worse. These occur usually, but not always, in patients who were taking steroid pills by mouth for asthma and those steroids were being slowly lowered or stopped. Although SINGULAIR has not been shown to cause this condition, **you must tell your doctor right away if you get one or more of these symptoms:**

- a feeling of pins and needles or numbness of arms or legs
- a flu-like illness
- rash
- severe inflammation (pain and swelling) of the sinuses (sinusitis)

These are not all the possible side effects of SINGULAIR. For more information ask your doctor or pharmacist. Talk to your doctor if you think you have side effects from taking SINGULAIR.

General Information about the safe and effective use of SINGULAIR

Medicines are sometimes prescribed for conditions that are not mentioned in patient information leaflets. Do not use SINGULAIR for a condition for which it was not prescribed. Do not give SINGULAIR to other people even if they have the same symptoms you have. It may harm them. **Keep SINGULAIR and all medicines out of the reach of children.**

Store SINGULAIR at 25°C (77°F). Protect from moisture and light. Store in original package.

This leaflet summarizes information about SINGULAIR. If you would like more information, talk to your doctor. You can ask your pharmacist or doctor for information about SINGULAIR that is written for health professionals.

What are the ingredients in SINGULAIR?

Active ingredient: montelukast sodium

SINGULAIR chewable tablets contain aspartame, a source of phenylalanine.

Phenylketonurics: SINGULAIR 4-mg and 5-mg chewable tablets contain 0.674 and 0.842 mg phenylalanine, respectively.

Inactive ingredients:

- **4-mg oral granules:** mannitol, hydroxypropyl cellulose, and magnesium stearate.
- **4-mg and 5-mg chewable tablets:** mannitol, microcrystalline cellulose, hydroxypropyl cellulose, red ferric oxide, croscarmellose sodium, cherry flavor, aspartame, and magnesium stearate.
- **10-mg tablet:** microcrystalline cellulose, lactose monohydrate, croscarmellose sodium, hydroxypropyl cellulose, magnesium stearate, hydroxypropyl methylcellulose, titanium dioxide, red ferric oxide, yellow ferric oxide, and carnauba wax.

What is asthma?

Asthma is a continuing (chronic) inflammation of the bronchial passageways which are the tubes that carry air from outside the body to the lungs.

Symptoms of asthma include:

- coughing
- wheezing
- chest tightness
- shortness of breath

What is seasonal allergic rhinitis?

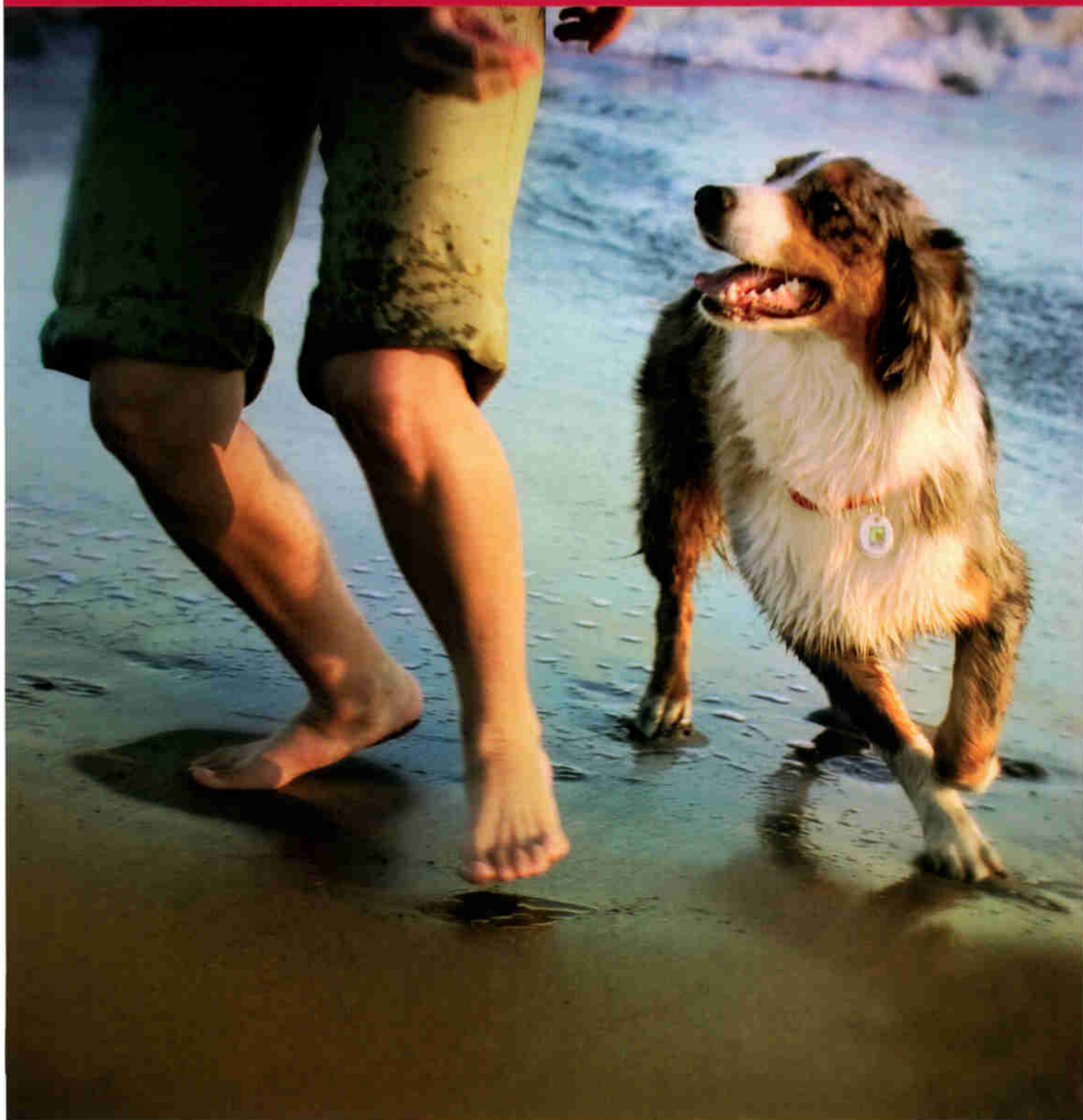
- Seasonal allergic rhinitis, also known as hay fever, is an allergic response caused by pollens from trees, grasses and weeds.
- Symptoms of seasonal allergic rhinitis may include:
 - stuffy, runny, and/or itchy nose
 - sneezing

Rx only

Issued April 2004

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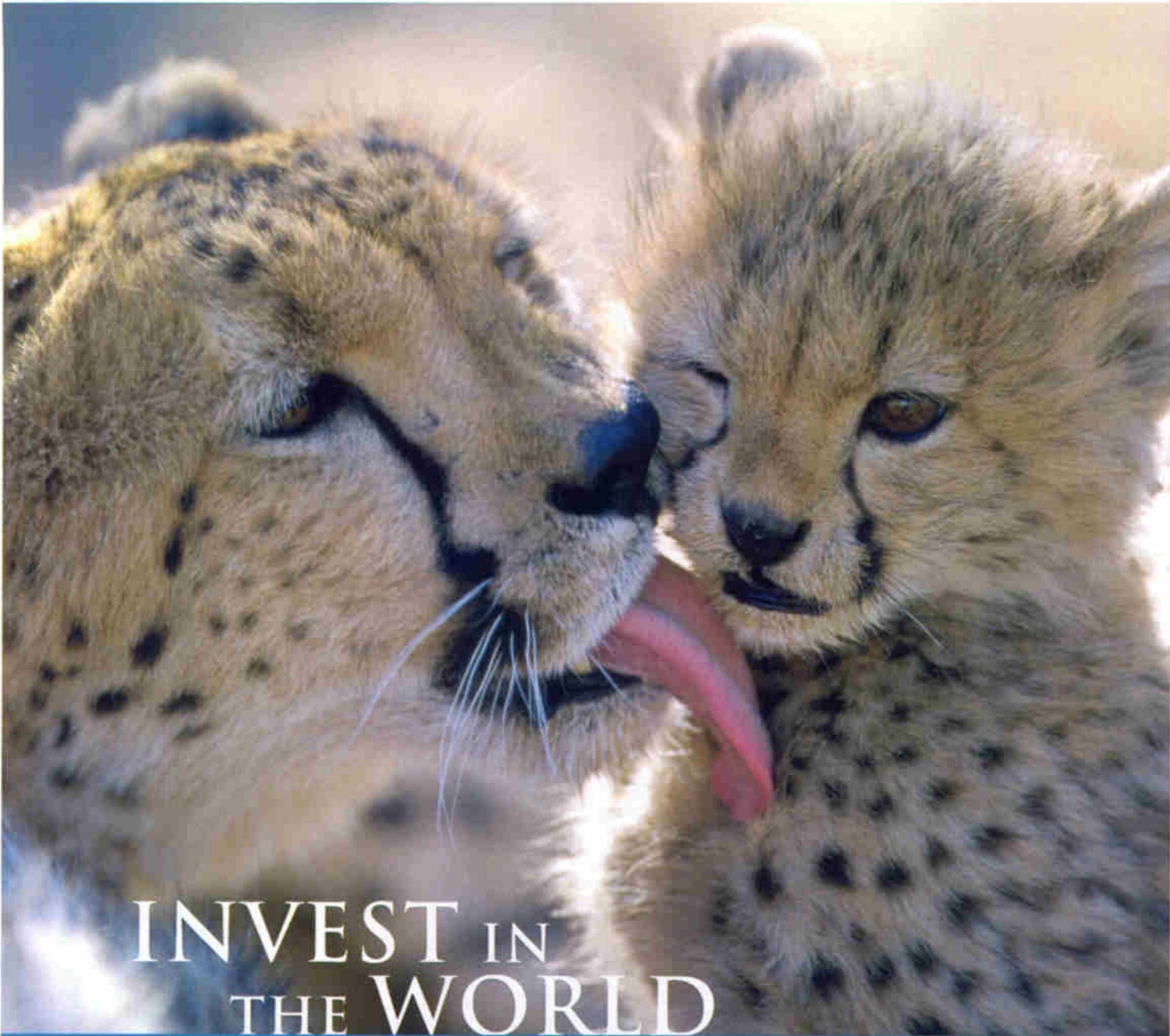


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70	6.5%	\$650	\$3,400.70
80	8.0%	\$800	\$4,585.20
90	11.3%	\$1,130	\$5,556.80

*For illustrative purposes only. Rates are recommended by the American Council on Gift Annuities, effective 7/03. Please check for rates for more than one annuitant. *Tax deductions will vary according to date and amount of gift. Always consult your advisers about philanthropic gifts.*



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For a Free Gift...Call Today!

A floor lamp that spreads sunshine all over a room, and pays for itself!



**CALL TODAY
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FREE SHIPPING****

*The Balanced Spectrum® floor lamp combines the benefits of natural daylight indoors with a savings of \$51 over the life of one bulb!**

Ever since the first human went into a dark cave and built a fire, people have realized the importance of proper indoor lighting. Unfortunately, since Edison invented the light bulb, lighting technology has remained relatively prehistoric. Modern light fixtures do little to combat many symptoms of improper lighting, such as eye-strain, dryness or burning. As more and more of us spend longer hours in front of a computer monitor, the results are compounded. And the effects of indoor lighting are not necessarily limited to physical well-being. Many people believe that the quantity and quality of light can play a part in one's mood and work performance. Now there's a better way to bring the positive benefits of natural sunlight indoors.

The Balanced Spectrum® floor lamp will change the way you see and feel about your living or work spaces. Studies show that sunshine can lift your mood and your energy levels. But as we all know the sun, unfortunately, does not always shine. So to bring the benefits of natural daylight indoors, use the floor lamp that simulates the full spectrum of daylight. You will see with more clarity and enjoyment as this lamp provides sharp visibility for close tasks and reduces eyestrain.

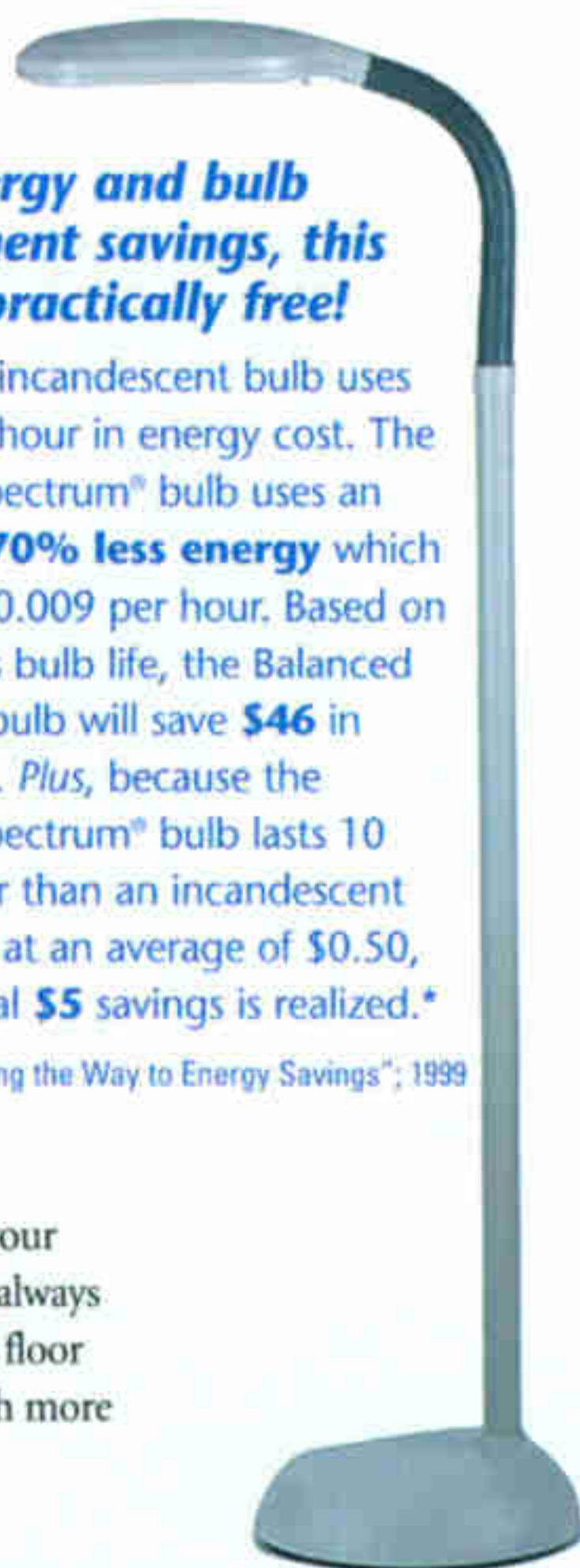
Its 27-watt compact bulb is the equivalent to a 150-watt ordinary light bulb. This makes it perfect for activities such as reading, writing, sewing, needlepoint, and especially for aging eyes.

We've looked at lots of lights, but this one offers the benefit of dual light levels of 27 and 18 watts of power equivalent to 150- and 100-watt incandescent bulbs. This lamp has a flexible gooseneck design for maximum efficiency, with an "Instant On" switch that is flicker-free. The high-tech electronics, user-friendly design, and bulb that lasts 10 times longer than an ordinary bulb make this lamp a must-have.

With energy and bulb replacement savings, this lamp is practically free!

A 150-watt incandescent bulb uses \$0.013 per hour in energy cost. The Balanced Spectrum® bulb uses an average of **70% less energy** which saves you \$0.009 per hour. Based on 5,000 hours bulb life, the Balanced Spectrum® bulb will save **\$46** in energy cost. *Plus*, because the Balanced Spectrum® bulb lasts 10 times longer than an incandescent bulb priced at an average of \$0.50, an additional **\$5** savings is realized.*

*Source: "Lighting the Way to Energy Savings"; 1999



Height as shown: 50"

"I sit in my comfortable chair after my husband has gone to bed, and I turn that lamp on. It makes it so nice because it's like daylight over my chair...I don't get sore eyes like I used to."

Grace A.
Margate, FL

1-year manufacturer's warranty...FREE! Now more than ever is the time to add sunshine to every room in your home at this fantastic low price! The Balanced Spectrum® floor lamp comes with a 1-year manufacturer's limited warranty and *firstSTREET*'s exclusive guarantee, free. Try this product for 90 days and return it for the product purchase price if not completely satisfied.

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ON ASSI

ON THE ROAD, IN THE FIELD,

THE MIND

Playing With Emotions

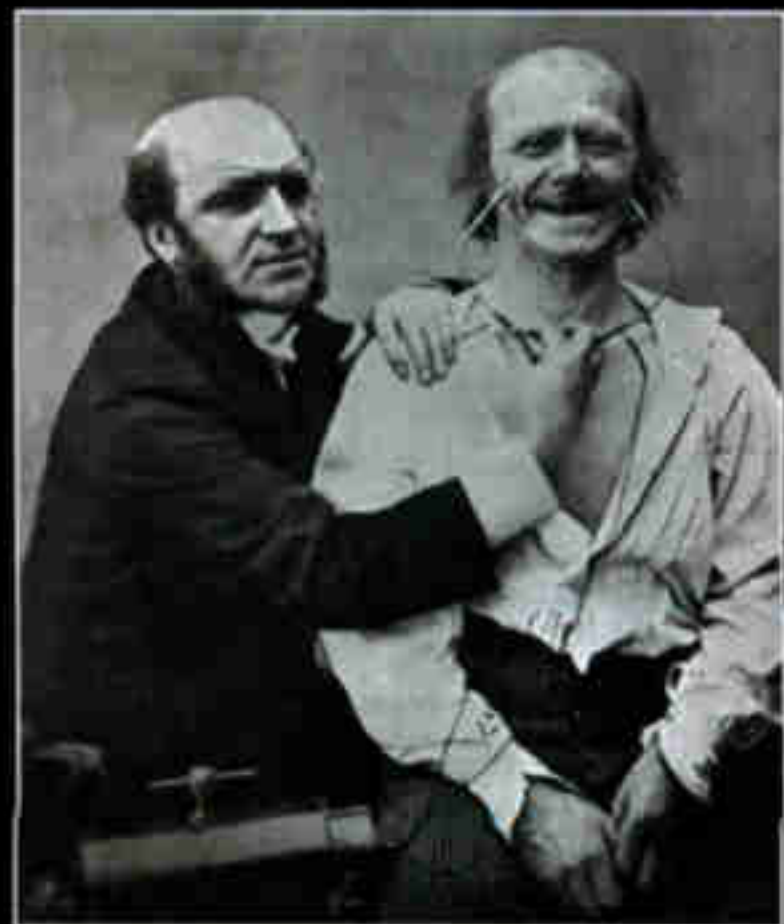
A photographer's lesson in reading (and making) faces

When photographer **Cary Wolinsky**, at right, first saw the work of Guillaume Duchenne, he was fascinated—and a little freaked out. The 19th-century French neurologist attached electrodes to his subjects and stimulated movement of their facial muscles with electrical current (inset at right).

Paul Ekman, above, an authority on the meanings of facial expressions, advised Cary on our story about the mind and knew all about Duchenne. He even performed an electrode-free “manipulation” of Cary’s face. But Paul was really there to

interpret and classify the facial expressions on the models Cary shot for the story (pages 18-19). “Paul is so good at reading faces,” Cary says, “it’s a little unnerving.”

You can test your own talent for reading faces, and further scientific knowledge, by taking part in a global survey of facial-expression interpretations at ngm.com/survey2005. You’ll look at images of faces, and name the emotions you see. The program then lets you compare your results with those of one of the country’s top cops and—for something completely different—*Monty Python* star John Cleese. Best of all: no electrodes.



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RANDY OLSON

INVASIVE SPECIES

Trouble in Paradise

“My experience of Hawaii as a tourist was always pleasant,” says photographer **Melissa Farlow** (above, second from left). “But when you’re with people who live there,” like Gladys Kanoa, at right, and her granddaughters, “you begin to understand what makes the place so special.”

The Kanoas farm the Hawaiian staple taro on Maui. Each year their crops are attacked by golden apple snails, which entrepreneurs introduced to Hawaii about 15 years ago, hoping to raise them as a luxury food. The escargot business never took off, but the snails made their way into the wild and flourished.

“The Kanoas have a good life,” Melissa says, “but it’s also a hard life, trying to live off the taro crop with the weather and all the other things farmers deal with.

The introduction of the invasive snails makes it that much harder.”

Melissa, an avid gardener, ended up with more than photos for the story. She discovered how widespread a phenomenon invasive species are, even appearing in her neighbor’s garden in western Pennsylvania.

“In the past I remember thinking, I like that plant, I wonder what it is.” Now she knows: It’s leafy spurge, an exotic, hard-to-kill devil’s weed that strangles native plants in the western U.S. and drives cows off in disgust. Melissa jokes that she’s ready to creep down her street at midnight, a bottle of weed killer in hand.

She also plans to sow some of what she learned on the story in her own garden. “Over the years native plants never seemed as interesting, but I’m really coming to appreciate them.”

WORLDWIDE

FREDERICK LAW OLMSTED

Writer **John Mitchell** and the great landscape architect both lived for a time on New York’s Staten Island. And both worked to protect the borough’s natural beauty. In the early 1870s Olmsted wrote a report insisting that the island’s central ridge be protected from development. When planners wanted to build a highway along the ridge in the 1960s, John and other activists opposing the road turned to Olmsted’s legacy for help. “We trotted out Olmsted’s old report, and that helped turn the fight our way,” he says. “Today there’s a big swath of green down the center of Staten Island.”

IRELAND UNDERWATER

Few divers think of Ireland when they plan trips, but perhaps they should, says photographer **Brian Skerry** (below). “It’s not a coral reef, obviously, but the biodiversity and the colors reminded me of the tropics.” In addition to seals and bottle-nose dolphins, were “blue lobsters, yellow sponges, and red anemones, all against a backdrop of emerald green water. The colors just blew me away.”



NIGEL MOTYER


TALES FROM THE FIELD Find more stories from our authors and photographers, including their best, worst, and *quirkiest experiences*, at nationalgeographic.com/magazine/0503.

Cialis is not for everyone. If you take nitrates, often used for chest pain (also known as angina), or alpha-blockers (other than Flomax 0.4 mg once daily), prescribed for prostate problems or high blood pressure, do not take Cialis. Such combinations could cause a sudden, unsafe drop in blood pressure. Don't drink alcohol in excess (to a level of intoxication) with Cialis. This combination may increase your chances of getting dizzy or lowering your blood pressure. Cialis does not protect a man or his partner from sexually transmitted diseases, including HIV.

The most common side effects with Cialis were headache and upset stomach. Backache and muscle ache were also reported, sometimes with delayed onset. Most men weren't bothered by the side effects enough to stop taking Cialis. Although a rare occurrence, men who experience an erection for more than 4 hours (priapism) should seek immediate medical attention. Discuss your medical conditions and medications with your doctor to ensure Cialis is right for you and that you are healthy enough for sexual activity.

Cialis® is a registered trademark of Lilly, ICOS LLC. Flomax® (tamsulosin HCl) is a registered trademark of its owner.

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Cialis (see-AL-iss) is the only erectile dysfunction (ED) tablet clinically proven to both work fast and work for up to 36 hours.* Having up to 36 hours lets you respond to your partner when the moment is right. Men with ED and their partners agree, Cialis improves erectile function for a satisfying experience.

Ask your doctor if prescription Cialis is right for you. See important safety information above and Patient Information on following page.

*Individual results may vary. Not studied for multiple attempts per dose. In clinical trials, Cialis was shown to improve, up to 36 hours after dosing, the ability of men with ED to have a single successful intercourse attempt.



Cialis®
(tadalafil) tablets

www.cialis.com

1-877-4-CIALIS

Patient Information

CIALIS® (See-AL-iss) **(tadalafil) tablets**

Read the Patient Information about CIALIS before you start taking it and again each time you get a refill. There may be new information. You may also find it helpful to share this information with your partner. This leaflet does not take the place of talking with your doctor. You and your doctor should talk about CIALIS when you start taking it and at regular checkups. If you do not understand the information, or have questions, talk with your doctor or pharmacist.

What important information should you know about CIALIS?

CIALIS can cause your blood pressure to drop suddenly to an unsafe level if it is taken with certain other medicines. You could get dizzy, faint, or have a heart attack or stroke.

Do not take CIALIS if you:

- take any medicines called "nitrates."
- use recreational drugs called "poppers" like amyl nitrate and butyl nitrate.
- take medicines called alpha blockers, other than Flomax® (tamsulosin HCl) 0.4 mg daily.

(See "Who should not take CIALIS?")

Tell all your healthcare providers that you take CIALIS. If you need emergency medical care for a heart problem, it will be important for your healthcare provider to know when you last took CIALIS.

After taking a single tablet, some of the active ingredient of CIALIS remains in your body for more than 2 days. The active ingredient can remain longer if you have problems with your kidneys or liver, or you are taking certain other medications (see "Can other medications affect CIALIS?").

What is CIALIS?

CIALIS is a prescription medicine taken by mouth for the treatment of erectile dysfunction (ED) in men.

ED is a condition where the penis does not harden and expand when a man is sexually excited, or when he cannot keep an erection. A man who has trouble getting or keeping an erection should see his doctor for help if the condition bothers him. CIALIS may help a man with ED get and keep an erection when he is sexually excited.

CIALIS does not:

- cure ED
- increase a man's sexual desire
- protect a man or his partner from sexually transmitted diseases, including HIV. Speak to your doctor about ways to guard against sexually transmitted diseases.
- serve as a male form of birth control

CIALIS is only for men with ED. CIALIS is not for women or children. CIALIS must be used only under a doctor's care.

How does CIALIS work?

When a man is sexually stimulated, his body's normal physical response is to increase blood flow to his penis. This results in an erection. CIALIS helps increase blood flow to the penis and may help men with ED get and keep an erection satisfactory for sexual activity. Once a man has completed sexual activity, blood flow to his penis decreases, and his erection goes away.

Who can take CIALIS?

Talk to your doctor to decide if CIALIS is right for you. CIALIS has been shown to be effective in men over the age of 18 years who have erectile dysfunction, including men with diabetes or who have undergone prostatectomy.

Who should not take CIALIS?

- Do not take CIALIS if you:
- take any medicines called "nitrates" (See "What important information should you know about CIALIS?"). Nitrates are commonly used to treat angina. Angina is a symptom of heart disease and can cause pain in your chest, jaw, or down your arm. Medicines called nitrates include nitroglycerin that is found in tablets, sprays, ointments, pastes, or patches. Nitrates can also be found in other medicines such as isosorbide dinitrate or isosorbide mononitrate. Some recreational drugs called "poppers" also contain nitrates, such as amyl nitrate and butyl nitrate. Do not use CIALIS if you are using these drugs. Ask your doctor or pharmacist if you are not sure if any of your medicines are nitrates.
 - take medicines called "alpha blockers", other than Flomax® 0.4 mg daily. Alpha blockers are sometimes prescribed for prostate problems or high blood pressure. If CIALIS is taken with alpha blockers other than Flomax® 0.4 mg daily, your blood pressure could suddenly drop to an unsafe level. You could get dizzy and faint.
 - you have been told by your healthcare provider to not have sexual activity because of health problems. Sexual activity can put an extra strain on your heart, especially if your heart is already weak from a heart attack or heart disease.
 - are allergic to CIALIS or any of its ingredients. The active ingredient in CIALIS is called tadalafil. See the end of this leaflet for a complete list of ingredients.

What should you discuss with your doctor before taking CIALIS?

Before taking CIALIS, tell your doctor about all your medical problems, including if you:

- have heart problems such as angina, heart failure, irregular heartbeats, or have had a heart attack. Ask your doctor if it is safe for you to have sexual activity.
- have low blood pressure or have high blood pressure that is not controlled
- have had a stroke
- have liver problems
- have kidney problems or require dialysis
- have retinitis pigmentosa, a rare genetic (runs in families) eye disease
- have stomach ulcers
- have a bleeding problem
- have a deformed penis shape or Peyronie's disease
- have had an erection that lasted more than 4 hours
- have blood cell problems such as sickle cell anemia, multiple myeloma, or leukemia

Can other medications affect CIALIS?

Tell your doctor about all the medicines you take including prescription and non-prescription medicines, vitamins, and herbal supplements. CIALIS and other medicines may affect each other. Always check with your doctor before starting or stopping any medicines. Especially tell your doctor if you take any of the following:

- medicines called nitrates (See "What important information should you know about CIALIS?")
- medicines called alpha blockers. These include Hytrin® (terazosin HCl), Flomax® (tamsulosin HCl), Cardura® (doxazosin mesylate), Minipress® (prazosin HCl) or Uroxatral® (alfuzosin HCl).
- ritonavir (Norvir®) or indinavir (Crixivan®)
- ketoconazole or itraconazole (such as Nizoral® or Sporanox®)
- erythromycin
- other medicines or treatments for ED

How should you take CIALIS?

Take CIALIS exactly as your doctor prescribes. CIALIS comes in different doses (5 mg, 10 mg, and 20 mg). For most men, the recommended starting dose is 10 mg. **CIALIS should be taken no more than once a day.** Some men can only take a low dose of CIALIS because of medical conditions or medicines they take. Your doctor will prescribe the dose that is right for you.

- If you have kidney problems, your doctor may start you on a lower dose of CIALIS.
- If you have kidney or liver problems or you are taking certain medications, your doctor may limit your highest dose of CIALIS to 10 mg and may also limit you to one tablet in 48 hours (2 days) or one tablet in 72 hours (3 days).

Take one CIALIS tablet before sexual activity. In some patients, the ability to have sexual activity was improved at 30 minutes after taking CIALIS when compared to a sugar pill. The ability to have sexual activity was improved up to 36 hours after taking CIALIS when compared to a sugar pill. You and your doctor should consider this in deciding when you should take CIALIS prior to sexual activity. Some form of sexual stimulation is needed for an erection to happen with CIALIS. CIALIS may be taken with or without meals.

Do not change your dose of CIALIS without talking to your doctor. Your doctor may lower your dose or raise your dose, depending on how your body reacts to CIALIS.

Do not drink alcohol to excess when taking CIALIS (for example, 5 glasses of wine or 5 shots of whiskey). When taken in excess, alcohol can increase your chances of getting a headache or getting dizzy, increasing your heart rate, or lowering your blood pressure.

If you take too much CIALIS, call your doctor or emergency room right away.

What are the possible side effects of CIALIS?

The most common side effects with CIALIS are headache, indigestion, back pain, muscle aches, flushing, and stuffy or runny nose. These side effects usually go away after a few hours. Patients who get back pain and muscle aches usually get it 12 to 24 hours after taking CIALIS. Back pain and muscle aches usually go away by themselves within 48 hours. Call your doctor if you get a side effect that bothers you or one that will not go away.

CIALIS may uncommonly cause:

- an erection that won't go away (priapism). If you get an erection that lasts more than 4 hours, get medical help right away. Priapism must be treated as soon as possible or lasting damage can happen to your penis including the inability to have erections.
- vision changes, such as seeing a blue tinge to objects or having difficulty telling the difference between the colors blue and green.

These are not all the side effects of CIALIS. For more information, ask your doctor or pharmacist.

How should CIALIS be stored?

- Store CIALIS at room temperature between 59° and 86°F (15° and 30°C).
- **Keep CIALIS and all medicines out of the reach of children.**

General information about CIALIS:

Medicines are sometimes prescribed for conditions other than those described in patient information leaflets. Do not use CIALIS for a condition for which it was not prescribed. Do not give CIALIS to other people, even if they have the same symptoms that you have. It may harm them.

This leaflet summarizes the most important information about CIALIS. If you would like more information, talk with your healthcare provider. You can ask your doctor or pharmacist for information about CIALIS that is written for health professionals.

For more information you can also visit www.cialis.com, or call 1-877-CIALIS1 (1-877-242-5471).

What are the ingredients of CIALIS?

Active Ingredient: tadalafil

Inactive Ingredients: croscarmellose sodium, hydroxypropyl cellulose, hypromellose, iron oxide, lactose monohydrate, magnesium stearate, microcrystalline cellulose, sodium lauryl sulfate, talc, titanium dioxide, and triacetin.

Rx only

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Who Knew?

VOLCANOLOGY

Big Chill

How Toba's eruption changed life on Earth

Once upon a time a volcano killed almost everybody. It's a radical and scary thought, but there's reason to think it may be true.

The disaster happened about 74,000 years ago on the island of Sumatra. The scar of the event is easily visible today: a lake named Toba, about 60 miles across at its longest dimension. It was only in 1929 that a Dutch geologist recognized the lake as a caldera.

A caldera is essentially a great hole in the Earth where the surface has collapsed after a massive volcanic eruption. The central part of Yellowstone National Park is a 35-by-45-mile example.

Eruptions that leave calderas this big don't happen often (Toba seems to be on a 400,000-year cycle, give or take a hundred thousand or so), but when they do, the effects can be global. Toba appears to have ejected some 670 cubic miles of material, as much as 560

times the amount produced by Mount Pinatubo in 1991. The ash and gas from Toba reached 30 miles into the stratosphere and shrouded the entire planet.

A super-eruption has multiple effects on the biosphere. Sulfur dioxide combines with water vapor to form sulfuric acid particles that scatter, reflect, and absorb sunlight. The planet's surface cools, the stratosphere heats, photosynthesis is reduced.

The more immediate effects are equally devastating. Bill Rose, a volcanologist at Michigan Tech University, is particularly interested in the fine ash produced by volcanoes. The ash rains from the sky in particles so small that they can penetrate an animal's lungs. "It's like smoking," he says.

"The birds die first," says Rose. "They get the ash in their feathers and they're immobilized. Then the larger animals start to die."

A lot of the humans died too, says Stanley H. Ambrose of the University of Illinois at Urbana-Champaign. Indeed, studies of mitochondrial DNA in humans point to a possible bottleneck of genetic diversity at roughly the same time as Toba's eruption, although

it's impossible to prove a link.

Ambrose does believe, however, that human behavior shows signs of change after Toba. Prior to the eruption, there's little evidence that humans engaged in long-distance networking. Afterward, humans in Kenya, some 4,000 miles from Toba, appear to have traveled up to 200 miles carrying obsidian objects. Ambrose's theory is that humans who learned to cooperate and give gifts would survive another crisis better than those who lived in isolated groups and did not practice altruism or reciprocity.

So you might say gifts saved the world, a heartwarming ending to this disaster story.

—Joel Achenbach

WASHINGTON POST STAFF WRITER

Fire and Ice

It wasn't until 1784 that a scientist suggested that volcanic eruptions could affect global climate. It was a year after the Laki fissure zone in Iceland erupted for eight months—the greatest outpouring of lava in historic time. Ash and sulfur dioxide spread through the atmosphere. Haze reduced sunlight, and acid rain destroyed crops and livestock. The scientist, residing in Paris at the time, puzzled over the strange weather and postulated to the philosophical society in Manchester, England, that the "universal fog" was a result of an Iceland eruption. That scientist was none other than Benjamin Franklin.

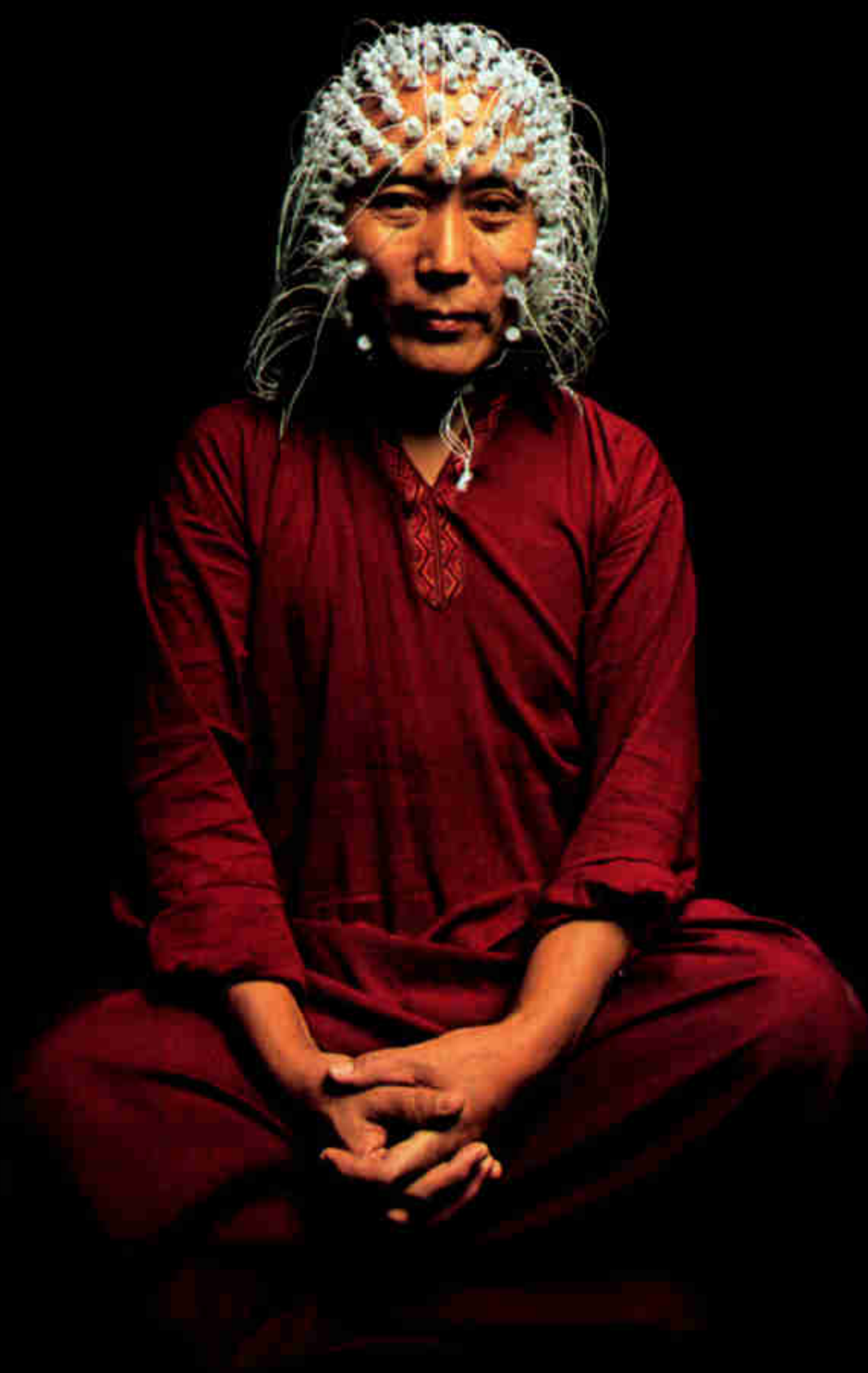
—Heidi Schultz

WEBSITE EXCLUSIVE For more on Toba's eruption, and for links to Joel Achenbach's work, go to Resources at nationalgeographic.com/magazine/0503.



PHOTO ILLUSTRATION BY
CARY WOLINSKY

the
mind
is what
the
brain
does



paths to the mind brain link

The ancient Egyptians thought so little of brain matter they made a practice of scooping it out through the nose of a dead leader before packing the skull with cloth before burial. They believed consciousness resided in the heart, a view shared by Aristotle and a legacy of

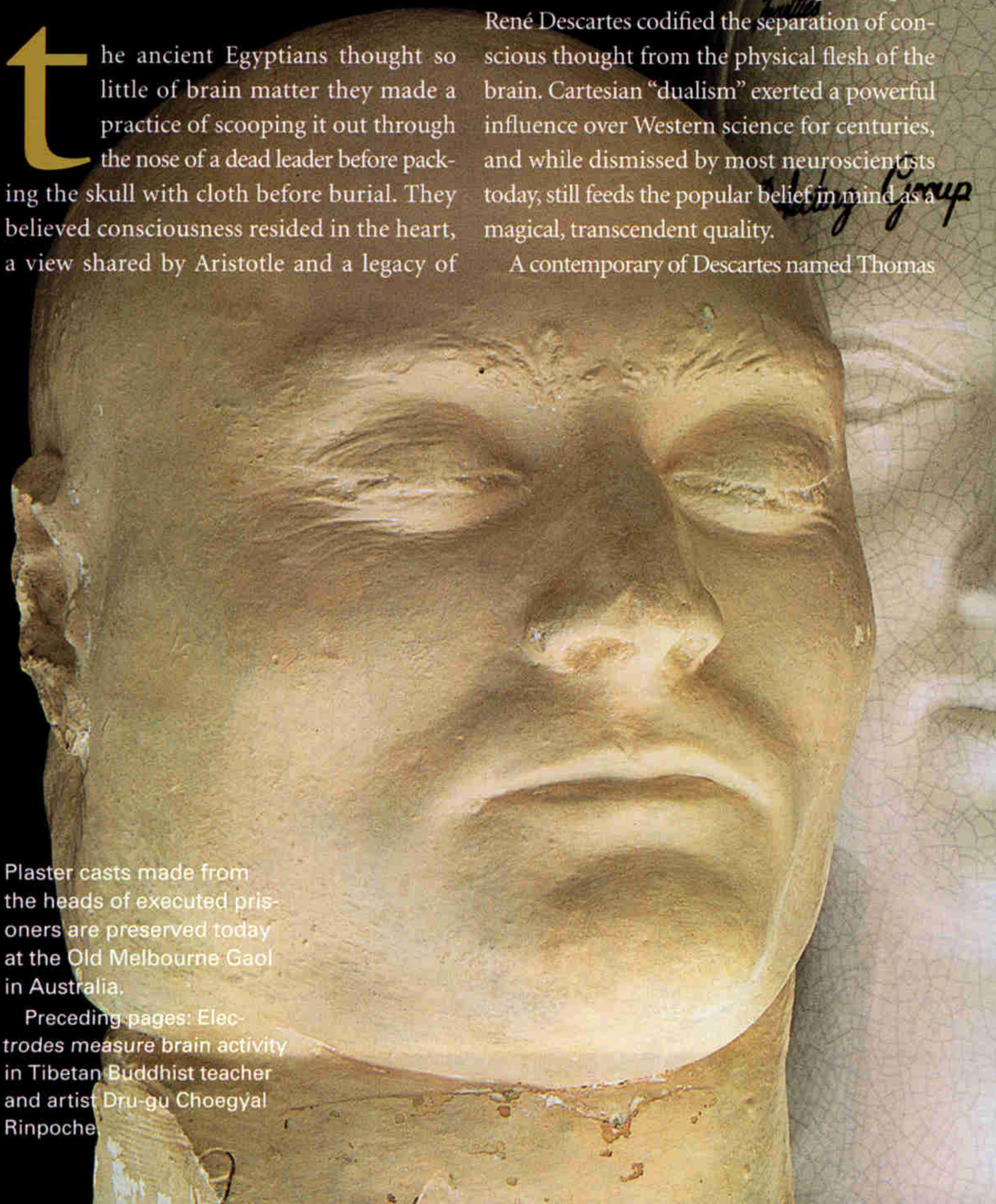
medieval thinkers. Even when consensus for the locus of thought moved northward into the head, it was not the brain that was believed to be the sine qua non, but the empty spaces within it, called ventricles, where ephemeral spirits swirled about. As late as 1662, philosopher Henry More scoffed that the brain showed “no more capacity for thought than a cake of suet or a bowl of curds.”

Around the same time, French philosopher René Descartes codified the separation of conscious thought from the physical flesh of the brain. Cartesian “dualism” exerted a powerful influence over Western science for centuries, and while dismissed by most neuroscientists today, still feeds the popular belief in mind as a magical, transcendent quality.

A contemporary of Descartes named Thomas

Plaster casts made from the heads of executed prisoners are preserved today at the Old Melbourne Gaol in Australia.

Preceding pages: Electrodes measure brain activity in Tibetan Buddhist teacher and artist Dru-gu Choegyal Rinpoche

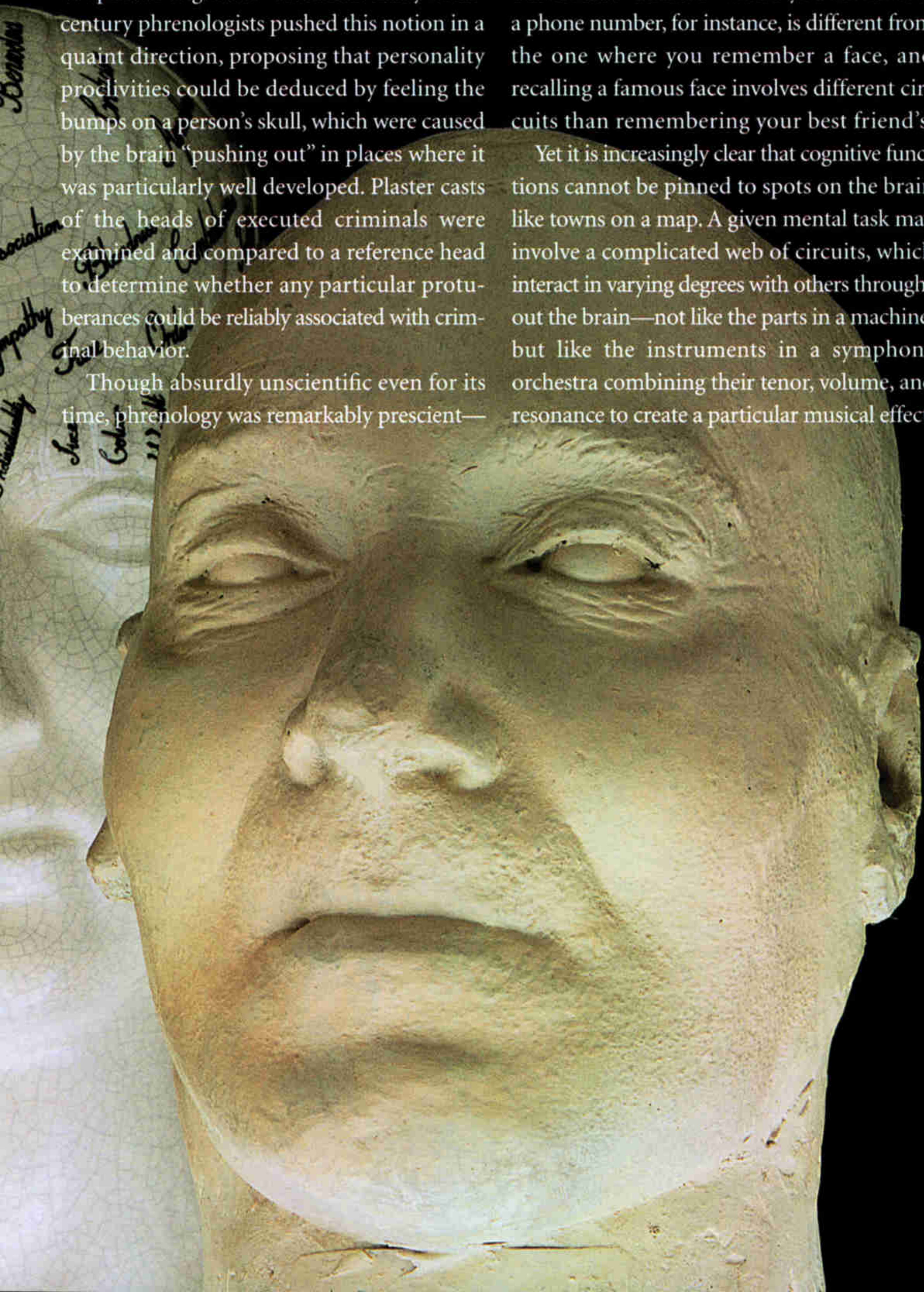


Willis—often referred to as the father of neurology—was the first to suggest that not only was the brain itself the locus of the mind, but that different parts of the brain give rise to specific cognitive functions. Early 19th-century phrenologists pushed this notion in a quaint direction, proposing that personality proclivities could be deduced by feeling the bumps on a person's skull, which were caused by the brain "pushing out" in places where it was particularly well developed. Plaster casts of the heads of executed criminals were examined and compared to a reference head to determine whether any particular protuberances could be reliably associated with criminal behavior.

Though absurdly unscientific even for its time, phrenology was remarkably prescient—

up to a point. In the past decade especially, advanced technologies for capturing a snapshot of the brain in action have confirmed that discrete functions occur in specific locations. The neural "address" where you remember a phone number, for instance, is different from the one where you remember a face, and recalling a famous face involves different circuits than remembering your best friend's.

Yet it is increasingly clear that cognitive functions cannot be pinned to spots on the brain like towns on a map. A given mental task may involve a complicated web of circuits, which interact in varying degrees with others throughout the brain—not like the parts in a machine, but like the instruments in a symphony orchestra combining their tenor, volume, and resonance to create a particular musical effect.



Corina's brain

all she is... is here

Corina Alamillo is lying on her right side in an operating room in the UCLA Medical Center. There is a pillow tucked beneath her cheek and a steel scaffold screwed into her forehead to keep her head perfectly still. A medical assistant in her late 20s, she has dark brown eyes, full eyebrows, and a round, open face.

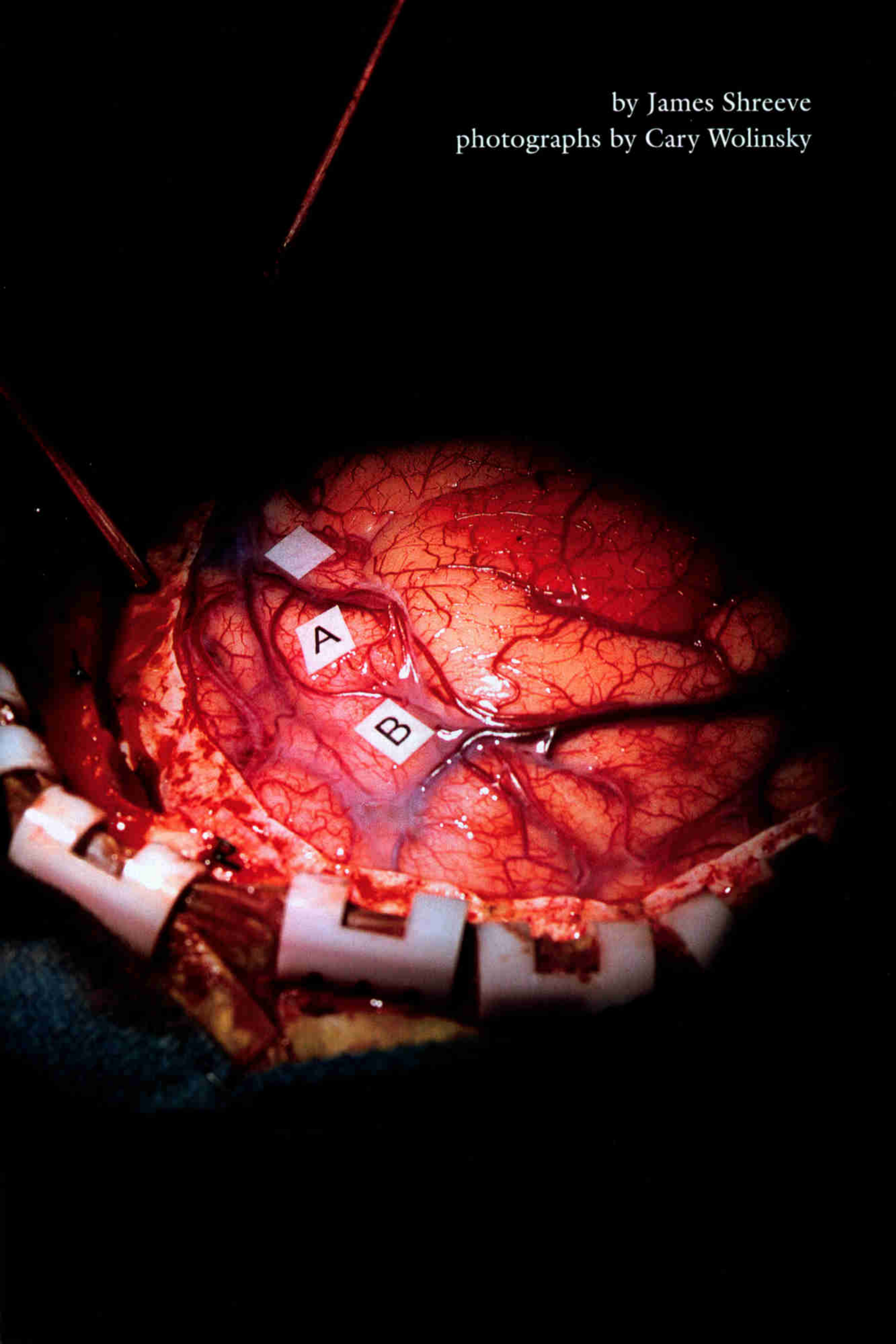
On the other side of a tent of sterile blue paper, two surgeons are hard at work on a saucer-size portion of Corina's brain, which gleams like mother-of-pearl and pulsates gently to the rhythm of her heartbeat. On the brain's surface a filigree of arteries feeds blood to the region under the surgeons' urgent scrutiny: a part of her left frontal lobe critical to the production of spoken language. Nearby, the dark, dull edge of a tumor threatens like an approaching squall. The surgeons need to remove the tumor without taking away Corina's ability to speak along with it. To do that, they need her to be conscious and responsive through the beginning of the operation process. They anesthetized her to remove a piece of her scalp and skull and fold back a protective membrane underneath. Now they can touch her brain, which has no pain receptors.

"Wake up, sweetie," says another doctor, sitting in a chair under the paper tent with Corina. "Everything is going fine. Can you say something for me?" Corina's lips move as she tries to answer through the clearing fog of anesthesia.

"Hi," she whispers.

The deep red hue of Corina's tumor is plain to see, even to a layperson leaning over the surgeon's shoulder. So is the surrounding tissue of her brain, a three-pound, helmet-shaped bolus of fat and protein, wrinkled like a cleaning sponge and with a consistency of curdled milk.

by James Shreeve
photographs by Cary Wolinsky



“¿Bicicleta?” she says. It’s not

Corina’s brain is the most beautiful object that exists, even more beautiful than Corina herself, for it allows her to perceive beauty, have a self, and know about existence in the first place. But how does mere matter like this make a mind? How does this mound of meat bring into being her comprehension of the doctor’s question, and her ability to respond to it? Through what sublime process does electrochemical energy become her hope that the operation will go well, or her fear for her two children if it should not? How does it bring into being her memory of clutching tight to her mother’s hand in the hospital room half an hour ago—or 20 years before in a store parking lot? These are hardly new questions. In the past few years, however, powerful new techniques for visualizing the sources of thought, emotion, and behavior are revolutionizing the way we understand the nature of the brain and the mind it creates.

The opening in Corina’s skull provides a glimpse into the history of the mind’s attempt to understand its physical being. The patch of frontal lobe adjacent to her tumor is called Broca’s area, named after the 19th-century French anatomist Paul Broca, one of the first scientists to offer definitive evidence that—while there is no single seat of thought—specific cognitive traits and functions are processed in localized regions of the brain.

Broca defined the area named for him by studying a stroke victim. In 1861 Broca met a patient who had been given the nickname “Tan,” because “tan” was the only syllable he had been able to utter for the past 21 years. When Tan died, an autopsy revealed that a portion of his left frontal lobe about the size of a golf ball had been liquefied by a massive stroke years before.

A few years later German neurologist Carl Wernicke identified a second language center farther back, in the brain’s left temporal lobe. Patients with strokes or other damage to Wernicke’s area are able to talk freely, but they cannot comprehend language, and nothing they say makes any sense.

Until recently, damaged brains were the best source of information about the origins of

normal cognitive function. A World War I soldier with a small-bore bullet wound in the back of his head might also, for instance, have a vacancy in his field of vision caused by a corresponding injury in his visual cortex. A stroke victim might see noses, eyes, and mouths, but not be able to put them together into a face, revealing that facial recognition is a discrete mental faculty carried out in the region of cortex destroyed by the stroke. In the 1950s American neurosurgeon Wilder Penfield used an electrode to directly stimulate spots on the brains of hundreds of epilepsy patients while they were awake during operations. Penfield discovered that each part of the body was clearly mapped out in a strip of cortex on the brain’s opposite side. A person’s right foot, for example, responded to a mild shock delivered to a point in the left motor cortex adjacent to one that would produce a similar response in the patient’s right leg. Stimulating other locations on the cortical surface might elicit a specific taste, a vivid childhood memory, or a fragment of a long-forgotten tune.

The two surgeons in the UCLA operating room are now about to apply Penfield’s technique to Corina’s Broca’s area. They’re already in the general neighborhood, but before removing her tumor they must find the exact address for Corina’s specific language abilities. The fact that she is bilingual requires even greater care than normal: The neural territories governing her English and Spanish may be adjacent, or—more likely, since she learned both languages at an early age—may at least partially overlap. Susan Bookheimer, the neuropsychologist communicating with Corina under the paper tent, shows her a picture on a card from a stack. At the same time, chief surgeon Linda Liau touches her brain with an electrode, delivering a mild shock. Corina feels nothing, but function is momentarily inhibited in that spot.

“What’s this, sweetie?” Bookheimer asks. Groggy, Corina stares at the picture.

“Saxophone,” she whispers.

“Good!” says Bookheimer, flipping through

a bicycle, it's a pair of antlers.

her stack of cards. The electrode is not touching a point critical to language. Meanwhile Liao moves the electrode a fraction of an inch. "And this one?"

"Unicorn."

"Very good. ¿Y éste?"

"Casa."

"¿Y éste?"

Corina hesitates. "¿Bicicleta?" she says. But it is not a bicycle; it is a pair of antlers. When Corina makes a mistake or struggles to identify a picture of some simple object, the doctors know they have hit upon a critical area, and they label the spot with a square of sterile paper, like a tiny Post-it note.

So far, this is all standard procedure. (Liao, whose own mother died of breast cancer that spread to her brain, has performed some 600 similar operations.) But the mapping of Corina's brain is about to take a turn into the future. There are a dozen people bustling about in the operating room, twice the number needed for a typical brain tumor operation. The extras are here to use optical imaging of intrinsic signals (OIS) during surgery, a technique being developed here at UCLA by Arthur Toga and Andrew Cannestra, one of the surgeons assisting Liao.

A special camera mounted on a boom is swung into position above Corina's frontal lobe. As she continues to name the pictures on the cards or responds to simple questions (What is the color of grass? What is an animal that barks?), the camera records minute changes in the way light is reflected off the surface of her brain. The changes indicate an increase in blood flow, which in turn is an indication of cognitive activity in that exact spot.

When Corina answers "green," or "dog," the precise pattern of neural circuits firing in her Broca's area and surrounding tissue is captured by the camera and sent to a monitor in the corner of the room. From there the image is instantly uploaded to a supercomputer in UCLA's Laboratory of Neuro Imaging, a few floors above. There it joins 50,000 other scans collected from over 10,000 individuals, using an array of imaging technologies. Thus Corina

becomes one galaxy in an expanding universe of new information on the human brain.

"Every person's brain is as unique as their face," says Toga, who directs the Laboratory of Neuro Imaging and is observing the operation today from above his surgical mask. "All this stuff is sliding around, and we don't know all the rules. But by studying thousands of people, we may be able to learn more of them, which will tell us how the brain is organized."

Most of the images in UCLA's brain atlas are produced by a groundbreaking new technique called functional magnetic resonance imaging (fMRI). Like OIS, fMRI monitors increases in blood flow as an indirect measurement of cognitive activity. But, while not nearly as precise, fMRI is completely noninvasive and can thus be used to study brain function not just in surgical patients like Corina, but in anyone who can tolerate spending a few minutes in the tubular cavity of an MRI machine. The technique has been used to explore the neural circuitry of people suffering from depression, dyslexia, schizophrenia, and a host of other neurological conditions. Just as important, it has been trained on the brains of hundreds of thousands of subjects while they perform a given task—everything from twitching a finger to recalling a specific face, confronting a moral dilemma, experiencing orgasm, or comparing the tastes of Pepsi and Coke.

What does the new science tell us about how Corina's 28-year-old brain produced Corina's 28-year-old mind? In terms of brain growth, her birth in Santa Paula, a farming community about 50 miles north of Los Angeles, was a non-event. In contrast, the previous nine months in her mother's womb were a neurodevelopmental drama of epic proportions.

Four weeks after conception, the embryo that would become Corina was producing half a million neurons every minute. Over the next several weeks these cells migrated to the brain, to specific destinations determined by genetic cues and interactions with neighboring neurons.

During the first and second trimesters of her mother's pregnancy the neurons began to reach tentacles out to each other, establishing synapses—points of contact—at a rate of two million a second. Three months before she was born, Corina possessed more brain cells than she ever would again: an overwrought jungle of connections. There were far more than she needed as a fetus in the cognitively unchallenging womb—far more, even, than she would need as an adult.

Then, just weeks away from birth, the trend reversed. Groups of neurons competed with each other to recruit other neurons into expanding circuits with specific functions. Those that lost died off in a pruning process scientists call “neural Darwinism.”

The circuits that survived were already partly tuned to the world beyond. At birth, she was already predisposed to the sound of her mother's voice over that of strangers; to the cadence of nursery rhymes she might have overheard in the womb; and perhaps to the tastes of her mother's Mexican cuisine, which she had sampled generously in the amniotic fluid. The last of her senses to develop fully was her vision. Even so, she clearly recognized her mother's face at just two days old.

For the next 18 months, Corina was a learning machine. While older brains need some sort of context for learning—a reason, such as a reward, to pay attention to one stimulus over another—baby brains soak up everything coming through their senses.

“They may look like they're just sitting there staring at things,” says Mark Johnson of the Centre for Brain and Cognitive Development at Birkbeck, University of London. “But right from the start, babies are born to seek information.” As Corina experienced her new world, neural circuits that received

Images of Corina Alamillo's head map functional activity in her brain. Such scans, made before surgery, may someday combine with others made during surgery to guide doctors as they strive to remove brain tumors without damaging surrounding tissue.





“Corina, you have a beautiful

repeated stimulation developed stronger synaptic connections, while those that lay dormant atrophied. At birth, for instance, she was able to hear every sound of every language on Earth. As the syllables of Spanish (and later English) filled her ears, the language areas of her brain became more sensitive to just those sounds, while losing their responsiveness to the sounds of, say, Arabic or Swahili.

If there is one part of the brain where the “self” part of Corina’s mind began, it would be in the prefrontal cortex—a region just behind her forehead that extends to about her ears. By the age of two or so, circuits here have started to develop. Before the prefrontal cortex comes on line, a child with a smudge on her cheek will try to wipe the spot off her reflection in a mirror, rather than understand that the image in the mirror is herself, and wipe her own cheek.

But as scientists are learning about all higher cognitive functions, they’re discovering that a sense of self is not a discrete part of the mind that resides in a particular location, like the carburetor in a car, or that matures all at once, like a flower blooming. It may involve various regions and circuits in the brain, depending on what specific sense one is talking about, and the circuits may develop at different times.

So while Corina may have recognized herself in a mirror before she was three years old, it might have been another year before she understood that the self she saw in the mirror persists intact through time. In studies conducted by Daniel Povinelli and his colleagues at the University of Louisiana at Lafayette, young children were videotaped playing a game, during which an experimenter secretly put a large sticker in their hair. When shown the videotape a few minutes later, most children over the age of three reached up to their own hair to remove the sticker, demonstrating that they understood the self in the video was the same as the one in the present moment. Younger children did not make the connection.

If Corina had a sticker caught in her hair when she was three, she doesn’t remember it.

Her first memory is of the thrill of going to the store with her mother to pick out a special dress, pink and lacy. She was four years old. She does not recall anything earlier because her hippocampus, part of the limbic system deep in the brain that stores long-term memories, had not yet matured.

That doesn’t mean earlier memories don’t exist in Corina’s mind. Because her father left when she was just two, she can’t consciously remember how he got drunk sometimes and abused her mother. But the emotions associated with the memory might be stored in her amygdala, another structure in the brain’s limbic system that may be functional as early as birth. While highly emotional memories etched in the amygdala may not be accessible to the conscious mind, they might still influence the way we act and feel beyond our awareness.

Different areas of the brain develop in various ways at different rates into early adulthood. Certainly the pruning and shaping of Corina’s brain during her early months as a learning machine were critical. But according to recent imaging studies of children conducted over a period of years at UCLA and the National Institute of Mental Health in Bethesda, Maryland, a second growth spurt in gray matter occurs just before puberty.

Assuming she was a typical girl, Corina’s cortex was thickest at the age of 11. (Boys peak about a year and a half later.) This wave of growth was followed by another thinning of gray matter that lasted throughout her teen years, and indeed has only recently been completed. The first areas of her brain to finish the process were those involved in basic functions, such as sensory processing and movement, in the extreme front and back of the brain. Next came regions governing spatial orientation and language in the parietal lobes on the sides of the brain.

The last area of the brain to reach maturity is the prefrontal cortex, where the so-called executive brain resides—where we make social judgments, weigh alternatives, plan for the future, and hold our behavior in check.

“The executive brain doesn’t hit adult levels

brain.” “Thank you,” she says.

until the age of 25,” says Jay Giedd of the National Institute of Mental Health, one of the lead scientists on the neuroimaging studies. “At puberty, you have adult passions, sex drive, energy, and emotion, but the reining in doesn’t happen until much later.” It is no wonder, perhaps, that teenagers seem to lack good judgment or the ability to restrain impulses. “We can vote at 18,” says Giedd, “and drive a car. But you can’t rent a car until you’re 25. In terms of brain anatomy, the only ones who have it right are the car-rental people.”

Gray-matter maturity, however, does not signal the end of mental change. Even now, Corina’s brain is still very much a work in progress. If there is a single theme that has dominated the past decade of neurological research, it is the growing appreciation of the brain’s plasticity—its ability to reshape and reorganize itself through adulthood. Blind people who read Braille show a remarkable increase in the size of the region of their somatosensory cortex—a region on the side of the brain that processes the sense of touch—devoted to their right index finger. Violin players show an analogous spread of the somatosensory region associated with the fingers of their left hand, which move about the neck of the instrument playing notes, as opposed to those of their right hand, which merely holds the bow.

“Ten years ago most neuroscientists saw the brain as a kind of computer, developing fixed functions early,” says Michael Merzenich of the University of California, San Francisco, a pioneer in understanding brain plasticity. “What we now appreciate is that the brain is continually revising itself throughout life.”

While the brain’s plasticity begins to degrade in later life, it may never be too late to teach an old brain new tricks. According to preliminary studies in Merzenich’s lab, even the memories of pre-senile individuals in their 60s and 70s can, with focused training, be dramatically rejuvenated. Plasticity does have limits, however. If certain critical areas of the cortex—

Broca’s area, for instance—are destroyed by stroke or tumor, the patient will probably never recover the function once performed by the now silent circuits.

Which brings us back to Corina today. Her tumor has already demolished an egg-size portion of her left frontal lobe containing circuits important to personality, planning, and drive. Fortunately, the brain has some built-in redundancy in these higher functions, and her family has not noticed any change in her personality: The corresponding region of her right frontal lobe is probably shouldering much of the extra load.

But the tumor must be removed now as quickly as possible. The scientists have finished the optical intrinsic imaging of her brain, plus another experimental scanning technique using infrared light. The camera’s boom has been rolled back.

The operating room empties of all but the personnel critical to the operation itself. Corina is very tired, but she must stay awake just a little longer. Using an electronic scalpel, Dr. Liao carefully begins to cut into the brain flesh at the border between the tumor and Corina’s Broca’s area. Under the tent, Dr. Bookheimer flashes more cards in front of her face.

“What’s this? A door? Good!”

“¿Y éste? . . .”

As the scalpel cuts deeper, Liao’s eyes are tense above her surgical mask. She must excise every scrap of cancerous tissue. Yet one slip, and the damage cannot be undone. Once the cut along the border is finished, Corina’s consciousness is no longer needed, and she can rest.

“How’s she doing?” asks Liao.

“Perfect,” says Bookheimer. “No problems at all.”

“Good,” says Liao. “Let’s put her back to sleep.” An anesthesiologist makes the required adjustment to the chemical mix trickling through Corina’s IV. I walk around to where I can see her face.

“Corina,” I say, as her eyes begin to close, “you have a beautiful brain.” She smiles faintly.

“Thank you,” she says.

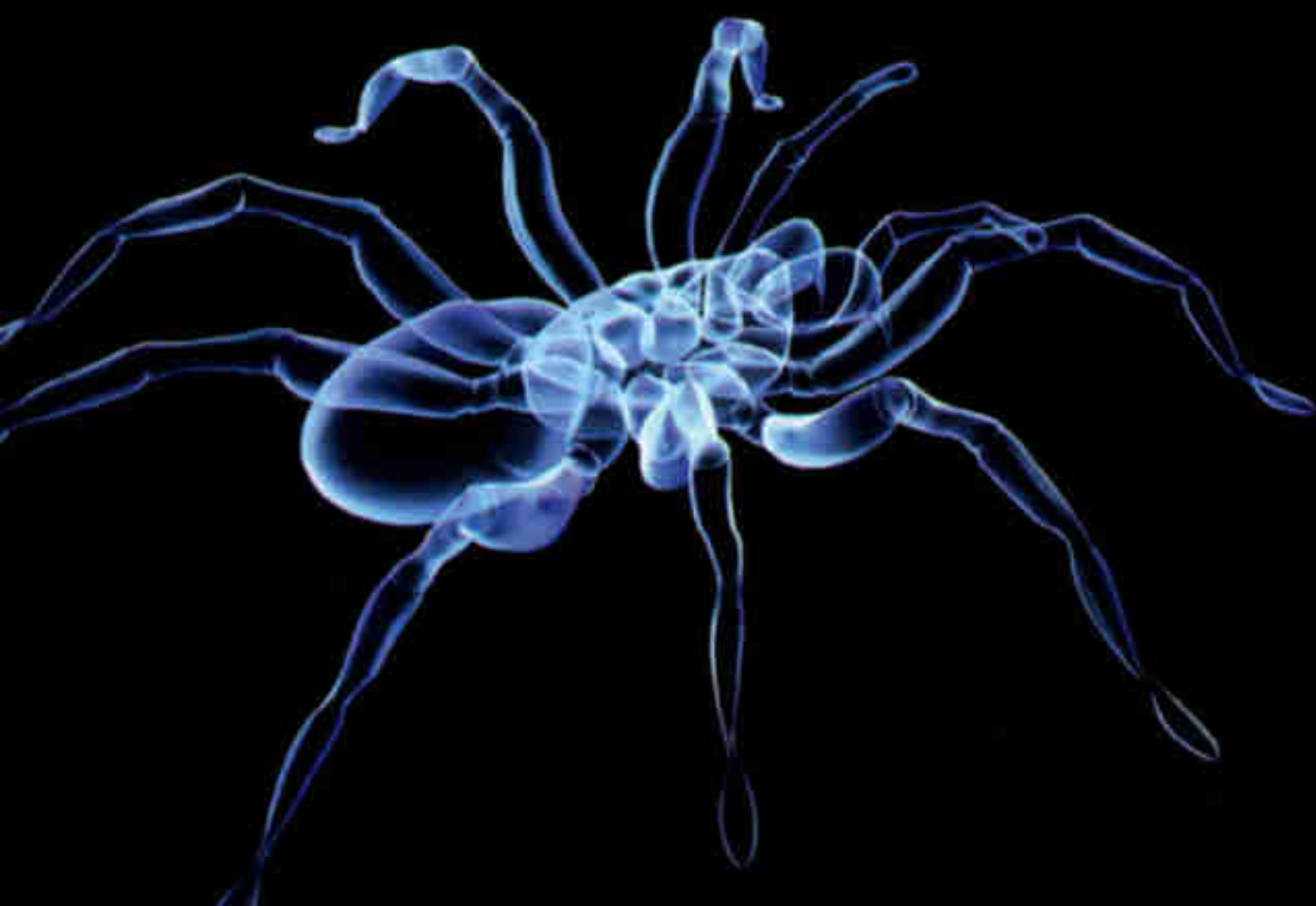
in the blink of an eye

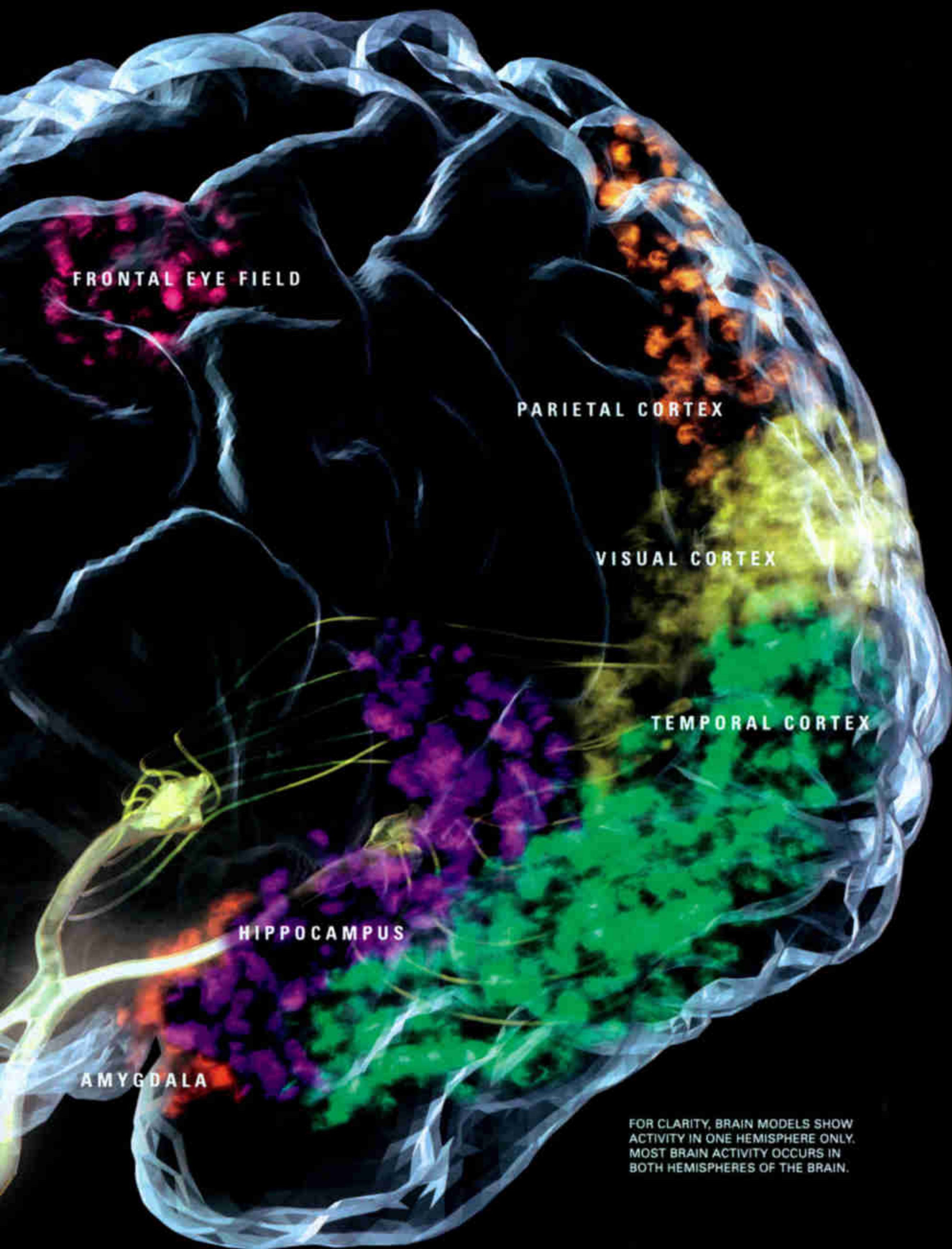
Scared of spiders? Then the flash of fear you feel when one creeps into view is visceral—and fast. How fast? Just fractions of a second, say neurologists. This illustration depicts that instant as it bolts across the geography of the brain, moving from a visual stimulus on the retinas to a dread felt deep in the mind.

Mapping brain functions requires innovative tools. With an electroencephalograph researchers analyze electrical currents to trace brain activity of blazing speed. And magnetic resonance imaging (MRI) can show which regions of the brain respond to specific stimuli or behavior. (Brain mapping by MRI yielded this color-enhanced image.)

“Looking at an object feels simple,” says Jacopo Annese, a neuroscientist at the Laboratory of Neuro Imaging at UCLA. “But the brain is processing very complex information in parallel.” The image is broken down into information about color, form, and orientation by segregated modules in the visual cortex. The resulting output is sent along to specialized areas that analyze the components and interpret more comprehensive aspects of the image.

“In the old days, people said the brain is like a computer,” says Arthur Toga, the lab’s director. “I’d say no. Images get decomposed and then recomposed. It’s very distributed, closer to the Internet.”





FOR CLARITY, BRAIN MODELS SHOW ACTIVITY IN ONE HEMISPHERE ONLY. MOST BRAIN ACTIVITY OCCURS IN BOTH HEMISPHERES OF THE BRAIN.

what

visual cortex
temporal cortex

From the retinas the spider's image travels along the optic tract and radiations to the visual cortex, where a map of the image is produced. The components of the image—color, form, orientation—are segregated and then processed along the temporal lobe, where the shape of the object is generated.

where

frontal eye field
parietal cortex

The frontal eye field tracks the position of the spider, directing eye movements and attention. The parietal cortex also receives input from the visual cortex and provides information on the bug's position. This feedback will be used to plan an action toward the bug.

recall

hippocampus

The hippocampus consolidates long-term memories and emotional content crucial for making decisions. Like the principal server on a computer network, it integrates visual information coming from the visual cortex with input from other senses and stored memories, resulting in full recognition of the spider.

react

amygdala

The amygdala immediately receives a first crude impression of the spider before the visual areas confirm its identity. This perception elicits an initial fear reaction. Fractions of a second later the visual cortex, temporal cortex, and hippocampus send precise information about the spider, confirming the reaction.



bigger brain

Every day, Glen McNeill spends six or seven hours buzzing about the streets of London on his motorbike with a map clipped to the handlebars. McNeill, 28, is a "knowledge boy," engaged in the years-long memory training required to earn his green badge and become a licensed London taxi driver, like his father.

If McNeill fulfills his dream, his brain may be the bigger for it, at least in one part. The hippocampus, a seahorse-shaped structure that is part of the brain's limbic system, is critical to many functions of memory and learning, including processing spatial relationships in the environment. An MRI study published in 2000 by scientists at University College, London, showed that in London taxi

drivers the rear portion of the hippocampus was enlarged compared with those of control subjects, confounding the long-held notion that the adult human brain cannot grow. But the bonus in brain tissue may not have come free of charge. On average, the front portion of the hippocampus was smaller than normal in the taxi drivers, suggesting that the effort to build an increasingly detailed mental map of the city had recruited neighboring regions to the cause.

If the hippocampus can grow in human adults, what about other parts of the brain? According to a recent study in Germany, learning how to juggle for three months resulted in an increase in the amount of gray

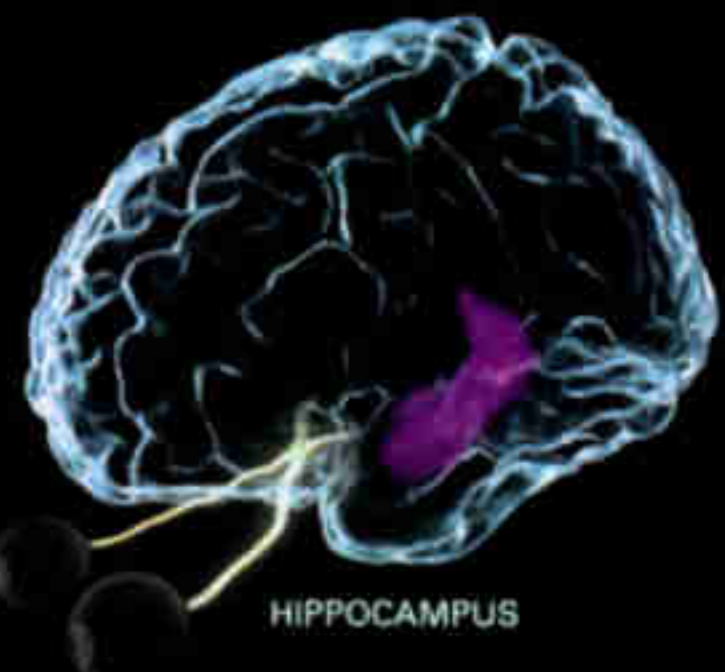


matter in two areas involved in visual and motor activity. When the newly trained jugglers stopped practicing, however, these regions shrank back. Furthermore, neither the driver study nor the juggler study could discern whether the growth in brain volume was due to the reorganization of existing circuits, an increased number of neural connections, or most intriguingly, the birth of actual new brain cells—an idea thought preposterous until recently. In 1998 Fred H. Gage of the Salk Institute in La Jolla, California, showed that new cells can indeed grow in the adult human hippocampus. Gage believes that stem cells, capable of developing into functioning new neurons, may exist elsewhere in

the brain. Better understanding of such nerve regeneration could provide hope for the treatment of Alzheimer's disease, Parkinson's disease, and a host of other degenerative brain disorders.

Meanwhile, Glen McNeill has more work to do with his hippocampus. He has to pass three sets of examinations testing his knowledge of London streets—and then prove familiarity with the surrounding towns.

"The suburbs is the last 'urdle," he says in his thick Cockney accent. "After that you get your lit'l green badge."





in your face

The man seems a trifle angry, doesn't he? Though we have no clue what triggered his reaction (he is in fact an actor), the emotion is written all over his face. Most of us will have no trouble reading it, no matter where we come from.

Forty years ago, psychologist Paul Ekman of the University of California, San Francisco, showed photographs of Americans expressing various emotions to the isolated Fore people in New Guinea. Though most of the Fore had never been exposed to Western faces, they readily recognized expressions of anger, happiness, sadness, disgust, and fear and surprise (which are difficult to differentiate). When Ekman conducted the experiment in reverse, showing Fore faces to Westerners, the emotions were again unmistakable. Ekman's now classic study gave powerful support to the notion that the facial expressions of basic emotions are universal, an idea first put forth by Charles Darwin.

According to Ekman, these six emotions (plus contempt) are themselves universal, evolved to prepare us to deal quickly with circumstances we believe will affect our welfare. Some emotional triggers are universal as well. A sudden invasion of your field of vision triggers fear, for instance. But most emotional triggers are learned. The smell of newly mowed hay will conjure up different emotions in someone who spent idyllic childhood summers in the country and someone who was forced to work long hours on a farm. Once such an emotional association is made, it is difficult, if not impossible, to unmake it.

"Emotion is the least plastic part of the brain," says Ekman. But we can learn to manage our emotions better. For instance, the shorter the time between the onset of an emotion and when we become consciously aware of it—what Ekman calls the refractory period—the more likely we are to double-check to see if the emotion is appropriate to the situation. One way to shorten the refractory period is to be aware of what triggers our various emotions.



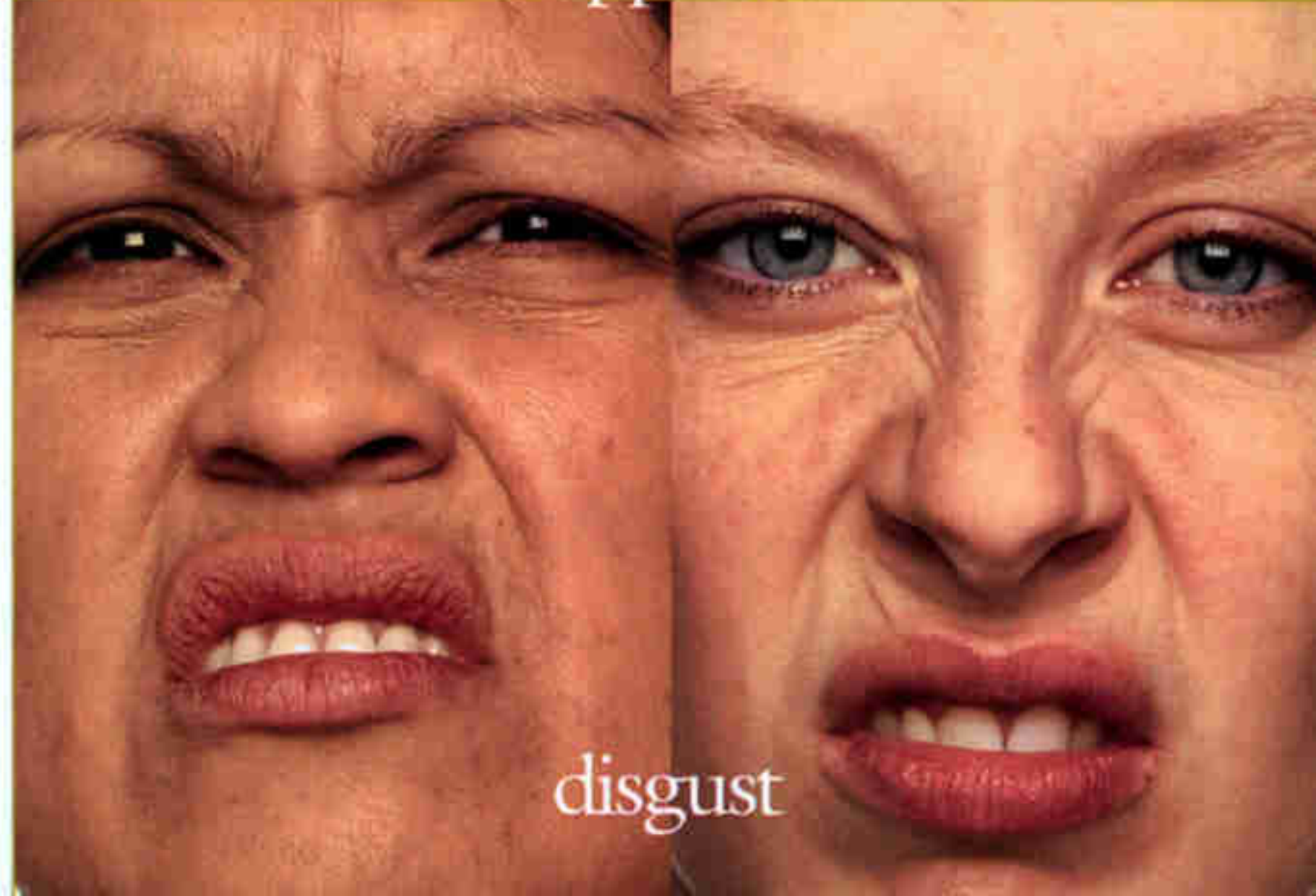
fear



sadness



happiness



disgust

MORE ON YOUR MIND Take 15 minutes to participate in a global survey to help scientists learn more about how we communicate with facial expressions. Find links to research studies reported in the story, and watch a video of photographer Cary Wolinsky to see how he posed a baby for a portrait with a python at nationalgeographic.com/magazine/0503.

It's a jungle out there, or at least it used to be. The prehistoric environment that shaped our brains sizzled with snakes, growling beasts, swooping birds, and other natural perils. Individuals who retreated spontaneously from such threats survived, while those who cogitated—maybe it's a friendly snake, but why is it coiling up like that?—did not live long enough to pass on their genes.

Natural selection may thus long ago have hard-wired the primate brain with a fear response to such dangers. On the other hand, experiments have shown that laboratory-raised monkeys that have never seen a snake in a natural setting show no more alarm at the sight of one than the young primate in the picture below, blithely nestled in the coils of an 11-foot python. So is fear of snakes in our nature or a product of our nurture?

In a series of studies at the University of Wisconsin–Madison in the 1980s, researchers tested the question by comparing lab-raised monkeys with monkeys born in the wild. Lab-raised monkeys with no previous fear of snakes began to show fear after watching wild-born monkeys, both live and in videotapes, show fear of snakes. But when videos were manipulated so that wild-born monkeys appeared to be afraid of flowers, lab-raised monkeys watching them didn't take the cue. It seems likely that there is indeed, etched into the primate brain, a predisposition to dread natural phenomena that can hurt us, but no predisposition to learn to fear something that will not. But the predisposition requires social



experience to be activated. As the lab-raised monkeys learned fear of snakes from other monkeys, the baby stands a good chance of acquiring a fear of snakes after watching other humans.

In more recent research, scientists have traced the neural pathways of fear to a small, almond-shaped structure in the brain's emotional system called the amygdala. It appears to translate the perception of danger into action in two ways.

Our cortex is constantly bombarded with information from our eyes, ears, and other sensory organs. One route for this pipeline sends a torrent of detailed, refined information from high-level cortical regions to the amygdala, which turbocharges the processing of fearful or other emotional stimuli

at the expense of less urgent information. If you're driving and listening to the news on the radio when the driver in front of you taps the brakes, your attention will quickly drop off the news report and signal your foot to move to the brake pedal. A second, even faster pathway sends crude information from the senses through subcortical regions directly to the amygdala, bypassing the cortex altogether. If the car in front makes a full-fledged panic stop, this more primitive pathway signals you to slam on the brakes—even before the information reaches the cortical regions that make you conscious of your actions. The milliseconds' head start on your reaction may be enough to mean the difference between life and death.



afraid of what?



autistic genius

Fifteen-year-old Tito Mukhopadhyay squats beside his mother on his bed, rocking, his hands flapping wildly. The gestures are typical of a severely autistic individual, as are his avoidance of eye contact and his unintelligible grunts and moans. But Tito is far from inarticulate. A visitor asks him why he is moving about so much.

"I know it looks different," he answers, using a pencil and paper to scrawl his reply. "But I got into this habit to find and feel my own scattered self."



Initially diagnosed as mentally retarded, he was dragged from one doctor to another in his native India by a mother desperate to find the cause of her son's abnormal behavior and language impairment. Through relentless, sometimes unorthodox, training she broke through the barrier of silence, teaching Tito to add and subtract, to enjoy literature, and eventually to communicate by writing, at first by tying a pencil to his hand. Because of her efforts Tito, rare among low-functioning

autistics, can describe with powerful clarity what the condition feels like from the inside.

Tito's vivid autobiographical reflections reveal a sensibility and intelligence greater than his years. In *Beyond the Silence*, written between the ages of eight and eleven and published in England in 2000 (published as *The Mind Tree* in the U.S. in 2003) he chronicles his early attempts to cope with the cacophony of disconnected information arriving through his senses and his profound struggle to control his own body and behavior. He wrote of two distinct selves, a thinking self "which was filled with learnings and feelings," and an acting self that was "weird and full of actions," over which he had no more control than if it belonged to another person altogether. "The two selves stayed in their own selves, isolated from each other."

"Tito's remarkable achievements haven't overcome his autism," says Michael Merzenich, a neuroscientist at the University of California, San Francisco, who has studied Tito. "There is still chaos occurring in his brain." Where does that chaos come from? There is no doubt that genes play a role in at least some forms of the disorder. Also, infants who later develop autism often undergo a period of abnormal rapid brain growth in the first year of life, which may be related to an overproduction of cells that carry nerve impulses in the brain's white matter.

Researchers Chris and Uta Frith at University College in London have pinpointed a suite of structures—one above the eyes, another near the ear, and a third high up on the sides of the brain—that allow us to infer what others are thinking and relate to people accordingly. These regions appear to be less active in individuals with autism and Asperger's syndrome, a milder form of the disorder. But other parts of the brain may also be involved, including the amygdala and the hippocampus. It is doubtful that a disorder with such a broad spectrum of symptoms and pathologies has any single cause.

"Men and women are puzzled by what I do," writes Tito. "Doctors use different terminologies to describe me. I just wonder."



PREFRONTAL CORTEX, TEMPORAL LOBE, AMYGDALA, HIPPOCAMPUS



Music is native to the human mind. There is not a culture on Earth that does not have it, and our brains are wired to apprehend and be moved by its

magic. By contrast, absolute or perfect pitch—the ability to identify a specific musical tone without hearing it in relation to another one—is an exceedingly rare gift, found in as few as one in 10,000 individuals in Western societies.

People who possess the trait can identify the sound of an E flat or G sharp as effortlessly as anyone else can see that a fire engine is red or the sky is blue. Not surprisingly, it is more common among musicians. Mozart had it, and so did Beethoven. But what accounts for this peculiar faculty?

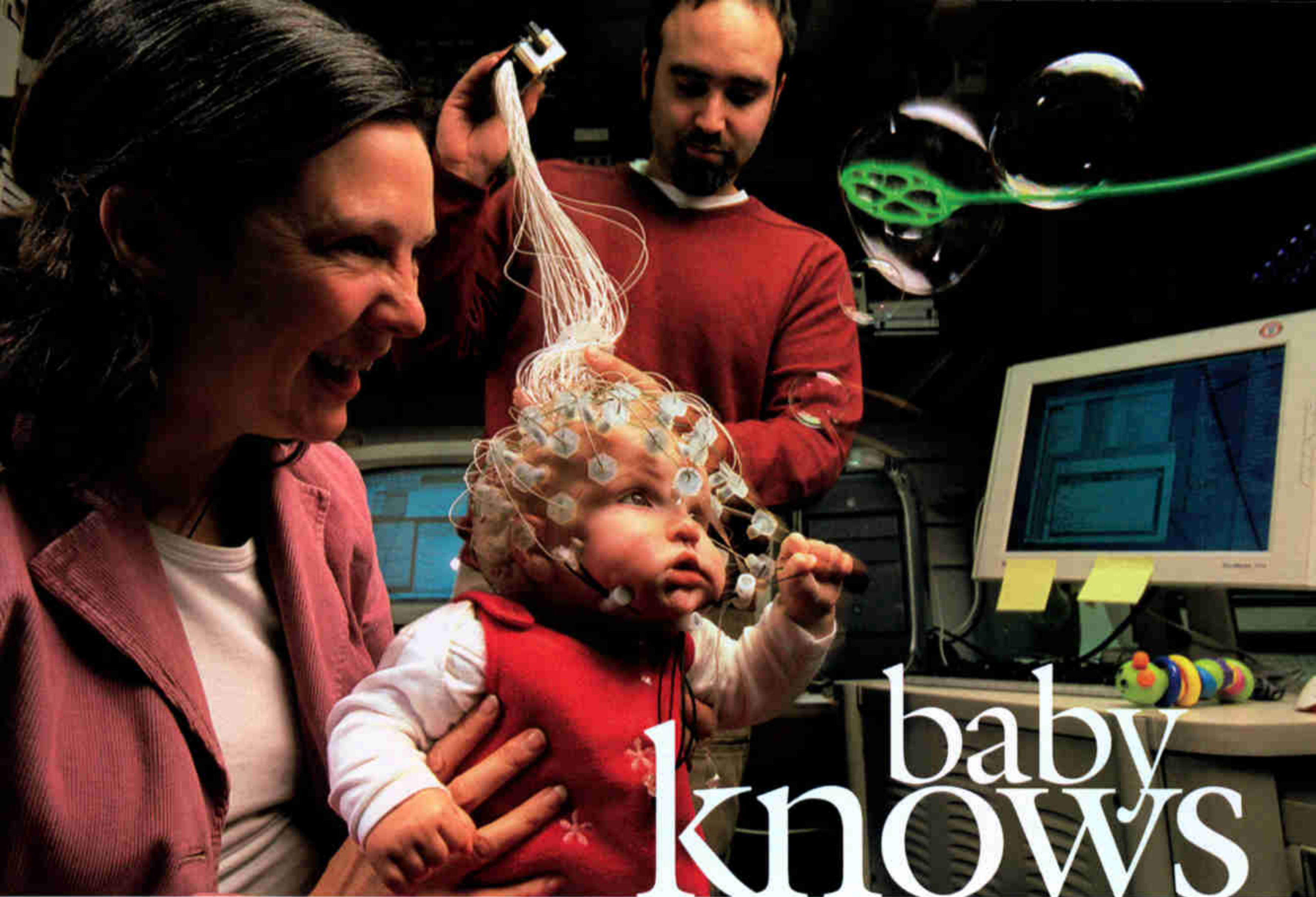
Some research suggests the phenomenon may not be so unusual after all. Investigators at the University of California, San Diego, found that many people who speak tonal

languages, such as Mandarin Chinese and Vietnamese, possess a form of absolute pitch, speaking words and repeating them days later at the same pitch. Another study found that 7 percent of non-Asian freshmen at the Eastman School of Music in Rochester, New York, were endowed with absolute pitch, as opposed to fully 63 percent of their Asian counterparts at the Central Conservatory of Music in Beijing.

But the relationship between absolute pitch and language cannot be the whole story. Not all tonal language speakers have absolute pitch, and not all absolute pitch possessors speak tonal languages. In Japan the trait is relatively common compared with the West, and Japanese is not a tonal language. Perhaps a genetic predisposition for absolute pitch is more common among Asian populations. But a more likely explanation for its prevalence in Japan may be the value the culture places on early music training, exemplified by these young violinists undergoing Suzuki Method training.

perfect pitch





baby knows

What goes on inside a baby's head? Infants cannot communicate their thoughts directly, of course, nor are they likely to lie still in the ear-splitting confinement of an MRI machine long enough for researchers to map activity in their brains. At Babylab, part of the Centre for Brain and Cognitive Development at Birkbeck, University of London, researcher Jordy Kaufman takes a direct route to reading a baby's mind.

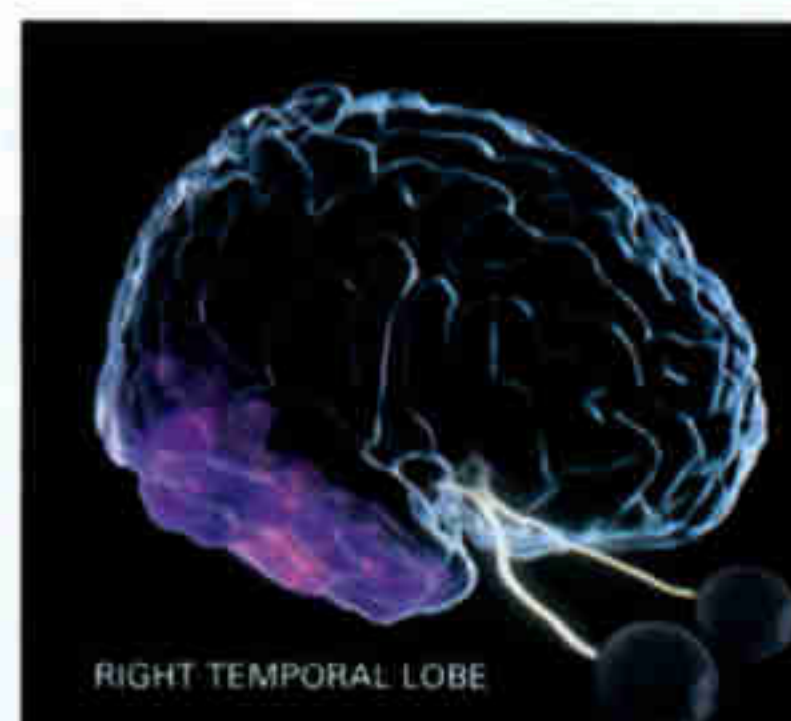
Kaufman outfits six-month-olds with helmets of electrodes to record electrical activity in their brains while they watch a video cartoon of a train disappearing into a tunnel.

Traditional behavioral studies have implied that *infants* lack a sense of object permanence: When an object they've been looking at is suddenly hidden from view, they behave as if the object no longer exists. But Babylab's high-tech hairnet records a burst of activity in babies' right temporal lobes as they watch the train disappear, similar to activity measured in adults who are asked to keep an unseen object in mind. And when the tunnel is lifted to reveal no train inside—a violation of object permanence—the electrical activity spikes upward, suggesting that the babies are trying to maintain a mental representation of the train in

the face of visual evidence to the contrary.

Does this mean that object permanence is prewired in the brain? Perhaps. But Kaufman prefers to see the development of mind as a fecund interaction between nature and nurture, as an infant's innate predispositions guide it to seek out experience that in turn nourishes and tunes specialized neural networks.

A predisposition to look at faces, for instance, seems to be innate, involving primitive brain regions. But Babylab's Hanife Halit has demonstrated that regions in the higher level temporal cortex become more specialized in facial recognition through the first year of life, at first responding to upright and upside-down monkey and human faces, and finally just to upright human faces. Normal babies also prefer faces that are looking back at them, while autistic children do not. Halit speculates that without an initial predisposition for engaging faces, a baby's brain might fail to be enriched by the social interactions that guide normal development—leading to the wholesale indifference to social stimuli that is one of the hallmarks of autism.



RIGHT TEMPORAL LOBE

altered mind

As recently as the late 1980s the human brain was considered to be a sort of biological computer that, as one scientist put it, "secretes thoughts the way kidneys secrete urine." We now know that the brain is much more malleable and fluidly organized than the analogy to computer hardware suggests, and that it changes with every perception and every action.

Over the past decade compelling evidence for neuroplasticity has come from studies of the blind by Alvaro Pascual-Leone, now a professor of neurology at Harvard University and Boston's Beth Israel hospital.

In the early 1990s Pascual-Leone and his colleagues at the National Institutes of Health showed that as blind adults learned to read Braille, the region of the somatosensory (touch-sensitive) cortex responding to input from the reading finger greatly enlarged. In 1996 the researchers made a more startling discovery: Input from the sensitized finger was lighting up not only the somatosensory cortex on the side of the brain, but parts of the visual cortex near the back of the brain as well.

Could it be that in adult blind people, new nerve connections were reaching out across the brain to occupy neural real estate left

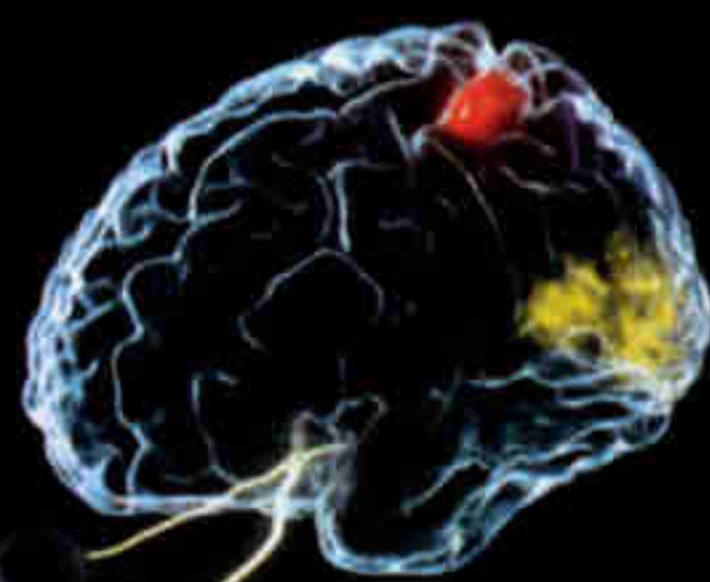


vacant by the lack of input from their sightless eyes? Pascual-Leone tests that notion by blindfolding sighted individuals for five days. After as few as two days, fMRI scans showed bursts of activity in their visual cortex when they performed tasks with their fingers, or even when they listened to tones or words. This was far too short a time for any nerve connections to grow from the touch and hearing regions of the cortex to the area processing sight. And after just a few hours with the blindfold removed, the visual cortex again responded only to input from the eyes.

So what accounts for this sudden ability of the brain to “see” with input from the fingers and ears? Pascual-Leone suggests the connections from these senses to the visual cortex may already be there but remain unused so long as the eyes are doing their job. When the eyes shut down, the next best way of

getting the same information springs into action.

“It’s provocative, but we’re arguing that the brain may not be organized into sensory modalities at all,” he says. What neuroscientists have been calling the visual cortex for the past century might not be devoted exclusively to the eyes, but should more accurately be defined as the area of the brain best able to discriminate spatial relationships—and it will grab whatever input is available to perform that task.



VISUAL CORTEX, PART OF SOMATOSENSORY CORTEX

THIS IS NOT A
LENDING LIBRARY

Books And Periodicals
May NOT Be Removed
From this Office Suite



On any given morning Alice Flaherty, a neurologist at Massachusetts General Hospital in Boston, is writing at her computer by 4:30 a.m. During the day she may also write on scrap paper, toilet paper, her surgical scrubs, and if nothing else is handy, on her own skin. Some of her best ideas come when she's in the shower, so she keeps a waxed pencil there and writes on the walls. She also has a pen attached to her bicycle, just in case the muse hits her in mid-pedal stroke.

These days Flaherty's writing obsession is as much pleasure as compulsion. But it grew out of the painful loss she experienced in 1998 at the deaths of her prematurely born twin boys. Already prolific, Flaherty developed a full-blown case of hypergraphia, a manic disorder characterized by an irrepressible urge to write—and write, and write. Her writing increased 20-fold. The nagging need to write something down would wake her up in the middle of the night to scribble in the dark, surrounding herself with a litter of scrawled notes. A second episode followed the birth of twin daughters, now healthy five-year-olds.

Flaherty's professional and personal interest in hypergraphia eventually led her to take the perhaps not surprising step of writing a book about it. While she speculates that her own worst episodes were triggered by the

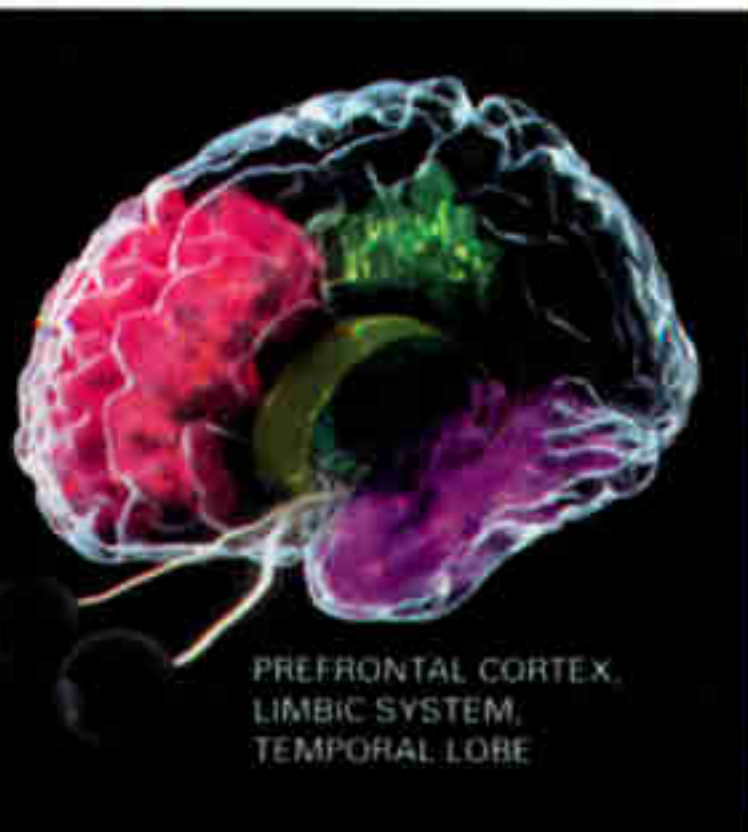
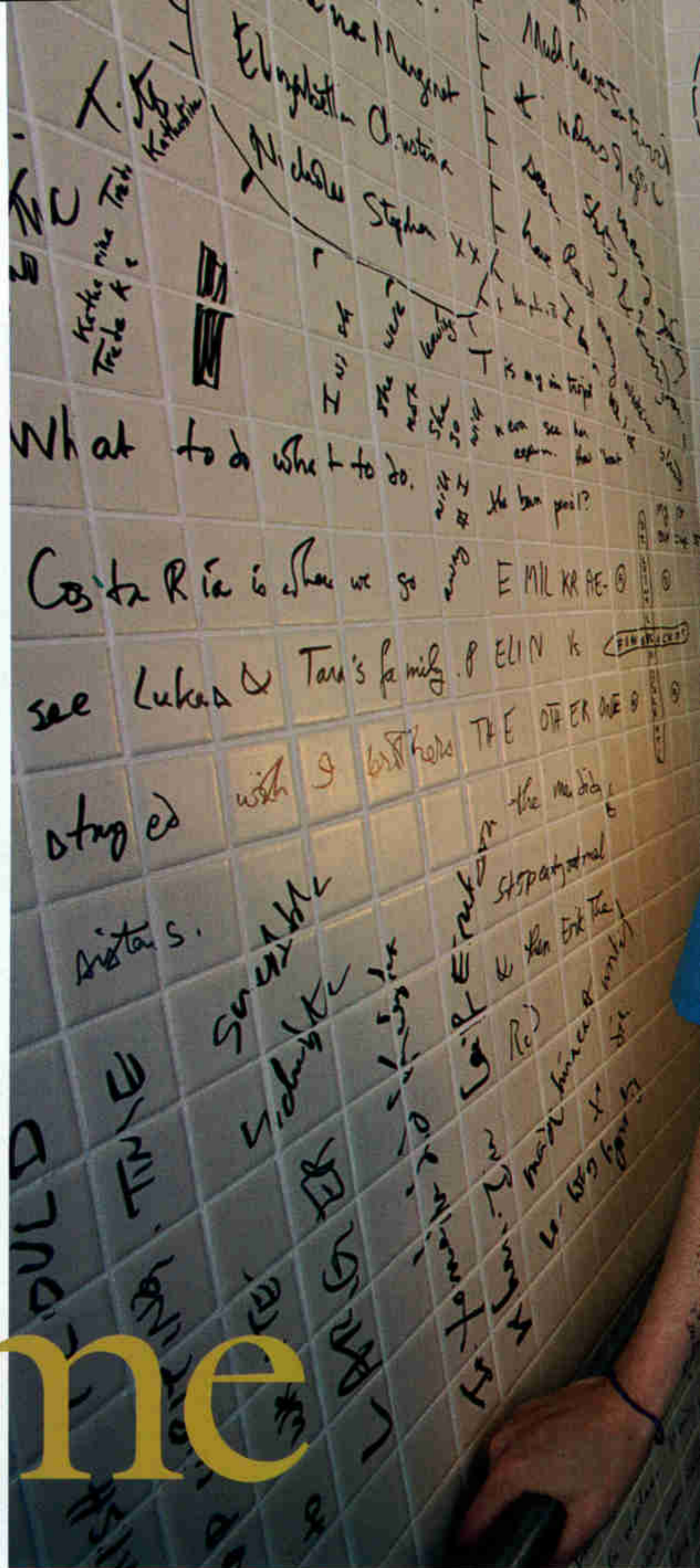
extreme expression

hormonal pandemonium accompanying birth, the condition is more commonly a symptom of manic depression, mania, and other mood disorders. It is most often associated with temporal lobe epilepsy, a disorder that may also lead to hyper-religious feelings

and a sense that even the most trivial events are filled with heightened meaning and cosmic importance. The

hypergraphic patient's compulsion to write all the time is not, alas, accompanied by any increase in talent. The diatribes of the Unabomber, Theodore Kaczynski, (or the verbal pablum of some Internet blogs) are typical output.

Nevertheless, the key role of the temporal lobe in hypergraphia may offer a window into the neural underpinnings of literary creativity, and creativity in general. According to popular wisdom, the right hemisphere of the brain is more creative, while the left brain is more



PREFRONTAL CORTEX,
LIMBIC SYSTEM,
TEMPORAL LOBE



logical and objective. While there is some basis for this belief, it is certainly an oversimplification. As Flaherty discusses in her book *The Midnight Disease: The Drive to Write, Writer's Block, and the Creative Brain*, more important to creativity may be the connections through the limbic system—the more primitive, emotional part of the brain—between the temporal lobes on the sides of the brain and the frontal lobes behind the forehead. While the frontal lobes may be important for providing the judgment and

flexibility of thought that underlies talent, structures in the temporal lobes and limbic system supply drive and motivation, which Flaherty believes are more important parts of the creative equation than talent itself. This applies not only to writing, but to all kinds of creative activity.

“To be a truly creative chess player,” she says, “probably just loving the game and playing it ten hours a day may be more important than having some special pattern recognition ability in your brain.”

spiritual estate





To focus the mind and increase awareness of self, Shingon Buddhists like Souei Sakamoto practice *takigyo*, chanting for hours while standing in frigid waterfalls at the Oiwasan Nissekiji Temple in Toyama, Japan.



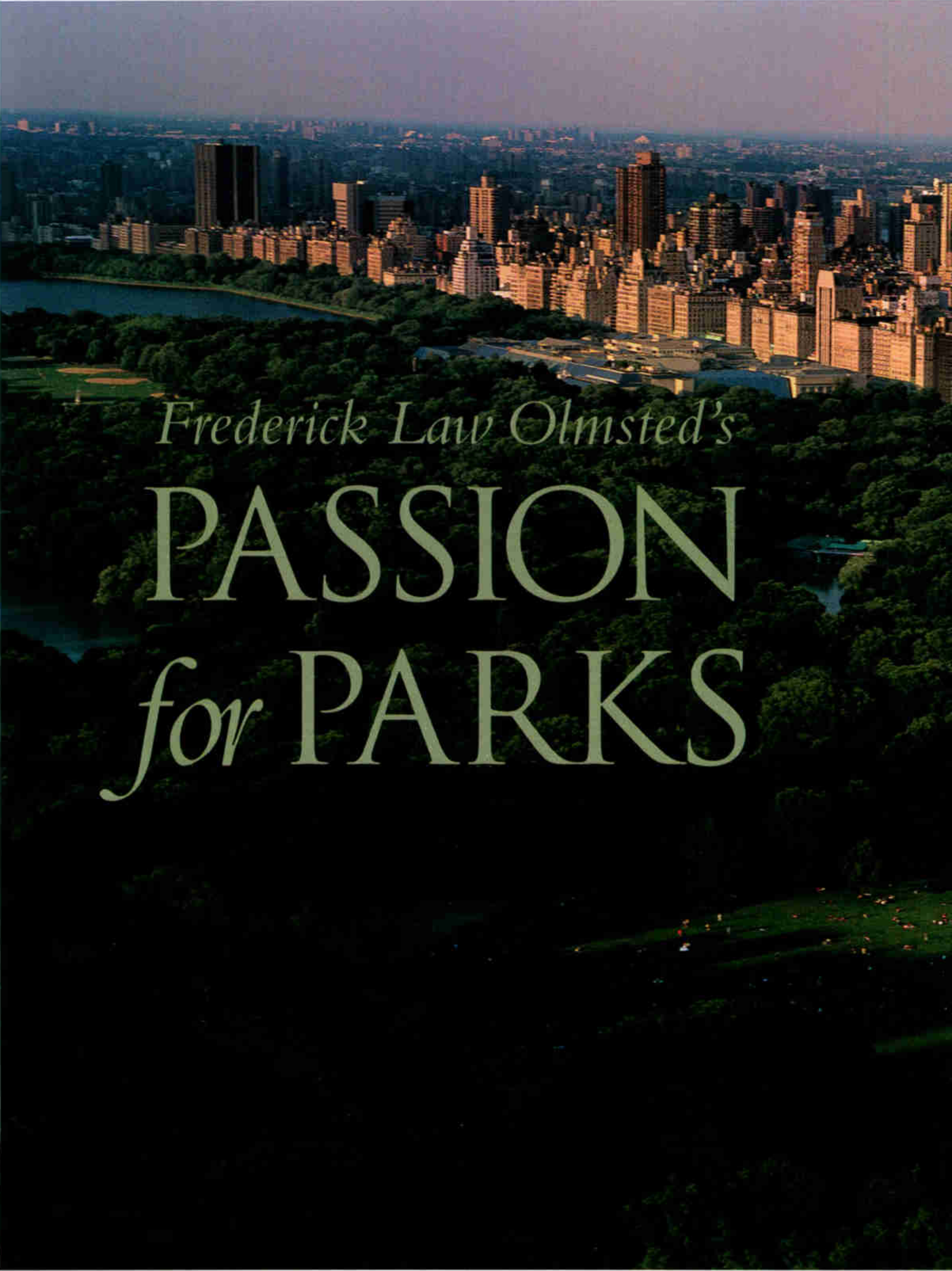
For 2,500 years Buddhists have employed such strict training techniques to guide their mental state away from destructive emotions and toward a more compassionate, happier frame of being. Spurred by the cascade of new evidence for the brain's plasticity, Western neuroscientists have taken a keen interest. Can meditation literally change the mind?

For the past several years Richard Davidson and his colleagues at the University of Wisconsin–Madison have been studying brain activity in Tibetan monks, both in meditative and non-meditative states. Davidson's group had shown earlier that people who are inclined to fall prey to negative emotions displayed a pattern of persistent activity in regions of their right prefrontal cortex. In those with more positive temperaments the activity occurred in the left prefrontal cortex instead. When Davidson ran the experiment on a senior Tibetan lama skilled in meditation, the lama's baseline of activity proved to be much farther to the left of anyone previously tested. Judging from this one study, at least, he was quantifiably the happiest man in the world.

Davidson recently tested the prefrontal activity in some volunteers from a high-tech company in Wisconsin. One group of volunteers then received eight weeks of training in meditation, while a control group did not. All the participants also received flu shots.

By the end of the study, those who had meditated showed a pronounced shift in brain activity toward the left, "happier," frontal cortex. The meditators also showed a healthier immune response to the flu shot, suggesting that the training affected the body's health as well as the mind's.

"You don't have to become a Buddhist," says the Dalai Lama himself, who is closely following the work of Western cognitive scientists like Davidson. "Everybody has the potential to lead a peaceful, meaningful life." □



Frederick Law Olmsted's
PASSION
for **PARKS**

Sunbathers catch the last rays of the day in New York's Central Park, a vale of tranquillity amid the metropolis. Here and in hundreds of public spaces across the country, Olmsted helped bring the soothing beauty of nature to rich and poor alike.



AN AMERICAN GARDEN
Central Park • New York, New York



THE APPROACH ROAD
Biltmore Estate • Asheville, North Carolina



Olmsted integrated natural terrain with landscaping to create moods of mystery and surprise.

His serpentine drive to the Biltmore house gives visitors "the sensation of passing through the remote depths of a natural forest" before encountering the grand château.

BY JOHN G. MITCHELL
PHOTOGRAPHS BY MELISSA FARLOW

YEARS EARLIER he had chosen the site for its natural features, for its lofty oaks and shagbark hickories, for the dappled green and gentle slope of Wellington Hill. These were his signature touches: a palette of light and shadow, the subtle layering of textures, a pastoral centerpiece edged with the leafy mysteries of the picturesque. He believed his plan might offer a measure of tranquillity to the McLean Hospital's mental patients. But now he was one of them, and the effect on him was anything but tranquil.



A PROLIFIC DESIGNER

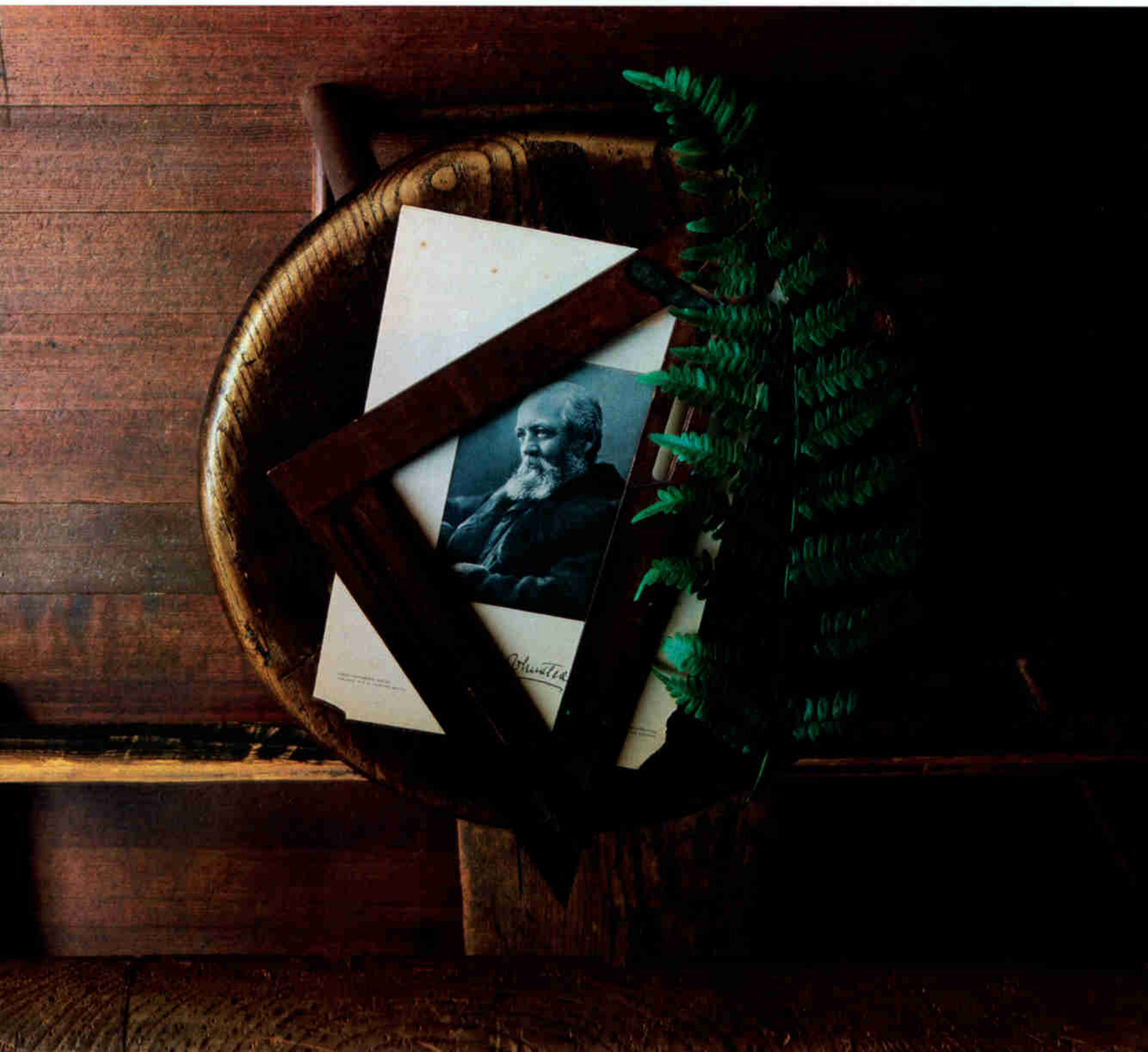
Fairsted Farmhouse • Brookline, Massachusetts

Protective wrappers that once held drawings for America's grandest landscapes remain in the vault at Fairsted, Olmsted's home and studio in Brookline, Massachusetts. More than 140,000 plans are carefully preserved at this national historic site. A compulsive workaholic, Olmsted (right) pondered the big picture, then designed down to the finest detail.



Near the end of a long life otherwise steeped in serendipitous good luck and brilliant achievement, Frederick Law Olmsted—maker of our nation's first great urban parks and founding father of landscape architecture in America—succumbed to a senile dementia so severe it demanded his confinement in this institution he had intended for others a generation before. The year was 1898; the place, Belmont, Massachusetts, not far from Boston. There, asylum staff watched over Olmsted among a cluster of cottages, one called Hope. The name had no relevance to his prognosis. Accompanied by a nurse or a family member, he strolled the grounds, his gift for observation not yet so dulled that he failed to note certain deviations from his original concept. "They didn't carry out my plans," he complained to his family. "Confound them!"

How bitterly in his bouts of paranoia Olmsted must have scorned the memory of a handful of other clients who failed to carry out his plans, confound them! Or were there moments at Belmont when a fading mind might have recalled the prouder legacies of a gifted career? Surely he could not forget the parks that had brought light and air and community soul to the crowded poor of Boston and Buffalo and Louisville and New York, among a score of cities. No forgetting some of the other designs his genius had wrought: of campuses and great estates, cemeteries and arboretums, the serene grounds of the United States Capitol, the grand esplanades of the World's Columbian Exposition at Chicago in 1893, the nation's first parkway (in New York), one of the first planned suburbs with curvilinear streets (Riverside,



Illinois), the reports demanding that Yosemite Valley and Niagara Falls be saved from the spoilers at a period in our history when commercial vandalism was even more in vogue than it is today.

Among the many tributes to this body of work, Olmsted might have remembered snatches of an editorial in *Garden and Forest* magazine hailing him, in the year of the Chicago exposition, as “the foremost artist which the New World has yet produced.” Still, though “millions of people now unborn will find rest and refreshment in the contemplation of smiling landscapes which he has made,” the “memory of his name and personality may be dimmed in the passage of years, for it is the fate of architects to be lost in their work.”

Within a half century of his death in 1903, the name of Frederick Law Olmsted was indeed largely forgotten, lost in works that had already lapsed “toward ruin” (in the words of one biographer) or yielded to the “vicissitudes of neglect” and the “mischief and caprice of citizens and politicians” (in the words of another). Then, in the early 1970s, around the sesquicentennial of his birth, the name of Olmsted enjoyed a revival of sorts—a show at the Whitney Museum of American Art in New York City, an increased interest in his long-restricted papers at the Library of Congress, the first of several contemporary biographies, the convening of conservancies to restore his neglected parks.

But the revival failed to arouse much public interest beyond the ranks of a relatively small circle of historians and park preservationists. Olmsted? *Oh, yes*, some folks would say, *wasn't he that fellow who did New York City's Central Park?*—as if that were enough to define a man



Working with various partners, Olmsted proposed and created parks, communities, and private estates across North America.

1. Boston Park System
2. Fairsted Farmhouse
3. Mount Royal Park
4. Central Park
5. Prospect Park
6. Rochester Park System
7. Buffalo Park System
8. Niagara Falls Reservation
9. U.S. Capitol Grounds
10. Biltmore Estate
11. Louisville Park System
12. Chicago: World's Columbian Exposition, Jackson Park
13. Village of Riverside
14. Yosemite Valley

who had left his prodigious mark on at least one other calling before turning, without either schooling or credentials, to his premiere profession: landscape architecture.

In my own time as a newspaper reporter in New York City, in those mid-century years preceding the revival, Olmsted's was a name not often invoked by the Press. Matter of fact, I'd never heard of him. Tabloid editors and gumshoe newshounds such as I were conditioned to see that great rectangular green in mid-Manhattan not as a public pleasuring ground but as a killing field, where teenage gangs clashed by night, and daybreak brought detectives from the Central Park Precinct to ponder yet another taped-off, blood-soaked crime scene. I lived on Staten Island then, across the bay. A local friend, a landscape architect named Bradford Greene, first introduced me to the Olmsted

story; told me how Olmsted had farmed on the island in his early years, later returned to prepare a report on the island's improvement (which predictably recommended no improvement at all to the natural scenery), and left behind a legacy that had hugely influenced Greene's own career in the shaping of landscapes.

Another good friend, Elizabeth Barlow Rogers, was about to become a force in the Olmsted revival and would later serve as Central Park administrator and first president of that park's conservancy. So it wasn't long before I felt obliged, out of self-defense, to get busy filling the gaps in my knowledge of this extraordinary man and his body of work. I'm still at it. “Following Olmsted's life,” wrote his most recent biographer, Witold Rybczynski, is like “putting together a picture puzzle. All sorts of odd-shaped pieces are lying on the table.”



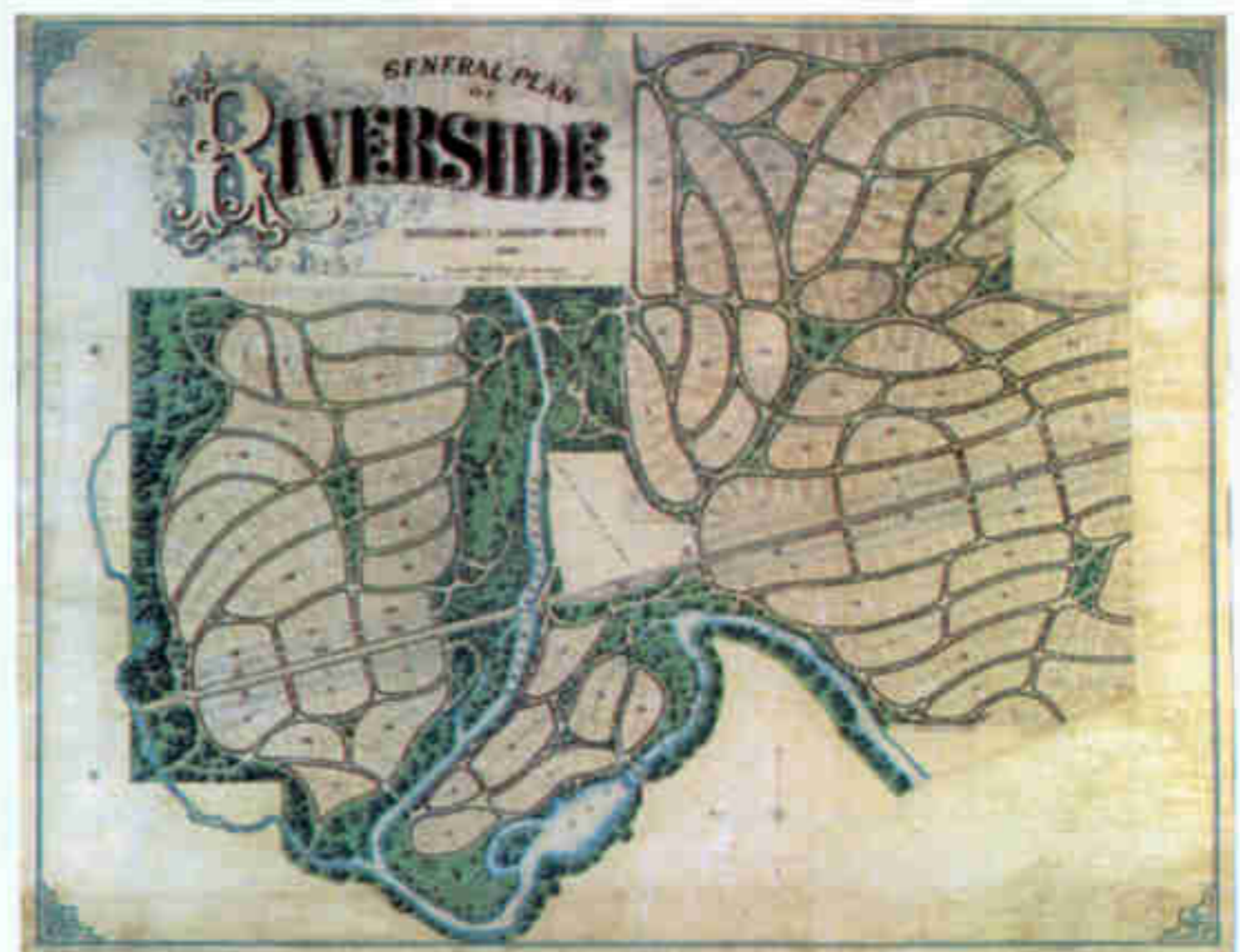
A PLANNED COMMUNITY

Red lights warn of a train's approach near the restored water tower in Riverside. Olmsted and Calvert Vaux's pioneering Chicago suburb offered country living with city conveniences.

The Vagabond

Frederick Law Olmsted was born April 26, 1822, in Hartford, Connecticut, first son of John Olmsted, a well-to-do dry goods merchant, and Charlotte Law Hull, who died when Frederick was almost four. The motherless boy was remanded into the custody of a succession of rural clergymen who instructed the child in reading, writing, and arithmetic. On holidays and summertimes, Frederick joined his father and new stepmother on carriage rides through the Connecticut backcountry. Both adults were much enthralled by Nature. So was the child.

He was hoping to attend Yale College, but a bad case of sumac poisoning had weakened his eyesight, and the doctors advised him to rest his eyes. Left to "run wild," as he later recalled it, he surrendered himself to a "vagabond life" and in his 21st year shipped out for China, a deckhand on the good bark *Ronaldson*. He returned a year



RIVERSIDE HISTORICAL MUSEUM

later, sick with the scurvy. Now the vagabond thought he might try his hand at farming: Perhaps the sandy soils of Staten Island might turn him a profit under cabbages and turnips. They didn't. He converted his fields into orchards and amused himself planting exotic trees.

In 1850 Olmsted sailed for England with his brother John. In their first month ashore they hiked some 300 miles through Wales and the Midlands, soaking up the rural scenery. "The country—and such a country!" Olmsted would write, "green, dripping, glistening, gorgeous!" But there were urban sights as well.



“A SENSE OF ENLARGED FREEDOM”

Prospect Park, Brooklyn, New York • Central Park, New York, New York

Little League games and loungers conflict with Olmsted’s pastoral vision of empty spaces in the Long Meadow of Prospect Park (above) and Central Park’s Sheep Meadow (right). He gave residents a rural experience few could afford.

At Birkenhead, across the River Mersey from Liverpool, they inspected the grounds of a new park designed by the innovative gardener Joseph Paxton. Olmsted was much impressed with the meandering footpaths and open meadows spangled with rocks and scattered trees. He wondered how cleverly “art had been employed to obtain from nature so much beauty.” And wonder of wonders, this was not just a sanctum for some noble lord but a park open to the public, a park for people of all stations in life. In all the cities of democratic America, he had to admit, there was nothing quite like it. Not yet, anyway.

The Scrivener

“If he had done nothing of note after the 1850s,” biographer Elizabeth Stevenson wrote in *Park Maker*, “if there had been no parks, if he had declined into worthy obscurity, Olmsted would still have a secure place

in American memory.” History and literature, she declared, would remember him as a man of words. Though he would write millions of them during his later careers as an administrator and landscape architect—his collected papers are said to number 60,000 separate items—Olmsted scored his highest writerly marks in the mid-19th century, a literary journalist at play in the fields of the antebellum South.

He had just published an account of his British travels, *Walks and Talks of an American Farmer in England*. The book was well received, especially by Henry Raymond, the editor of the *New-York Daily Times*, who was looking for a correspondent to tour the southern states and file a series of unvarnished reports on how slavery was affecting the region’s culture and economy. Now he had one.

In his earliest dispatches to the *Times*, Olmsted had tried to remain impartial on the



slavery question. But his travels increasingly exposed him to the cruel side of the cotton culture, with all of its moral implications, and he began to realize that servile labor had manifestly depleted the South's soil as surely as it sapped the region's economic vitality. In 1861, shortly after the first shots were fired in the war that would bring an end to slavery, his southern writings were collected in two volumes as *The Cotton Kingdom*, a classic still in print.

Olmsted's literary achievements also included a hitch at *Putnam's Monthly Magazine*, where he published Herman Melville's *Benito Cereno* and Henry David Thoreau's *Cape Cod*. Later he and a friend founded *The Nation*, still extant and the country's longest running weekly magazine. It was between those two experiences that Olmsted managed to land his biggest job—as superintendent of New York City's yet-to-be-constructed Central Park.

The Administrator

The park that Olmsted built in mid-Manhattan is possibly the world's most widely admired municipal open space. Through its many elegant arches and down its winding paths each year stroll millions of appreciative visitors from near and far, few even remotely aware of the park's shabby origin or of its evolution out of chaos into a place of uncommon beauty.

Hired as superintendent in 1857, thanks largely to recommendations from such literary friends as Washington Irving and William Cullen Bryant, Olmsted found the 770-acre site “a very nasty place” speckled with squatters' huts and swamps “steeped in the overflow and mush of pigsties, slaughter houses and bone-boiling works.” He attacked this squalor with an army of immigrant laborers that would soon number more than 3,000. Over the years, Olmsted's



"THE GREATEST GLORY OF NATURE"

Yosemite National Park • California



During a stint managing California gold mines, Olmsted became enthralled with Yosemite Valley and its "placid pools which reflect the wondrous heights." Advocating for its protection, he planted the seeds for the National Park System.

brigade would shuffle ten million cartloads of rock and dirt in or out of the park and plant an estimated four million to five million trees and shrubs, all in fulfillment of an elaborate design known as Greensward.

A cooperative effort by the superintendent and his new partner, the English-born architect Calvert Vaux, the Greensward plan had one great purpose, and that, as Olmsted saw it, was “to supply to the hundreds of thousands of tired workers, who have no opportunity to spend their summers in the country, a specimen of God’s handiwork that shall be to them, inexpensively, what a month or two in the White Mountains or the Adirondacks is, at great cost, to those in easier circumstances.”

The Civil War interrupted Olmsted’s work at Central Park. In lieu of military service, he accepted a post as general secretary of a volunteer relief force, the U.S. Sanitary Commission, which would care for the sick and wounded of the Union Army and otherwise function as a kind of precursor to the American Red Cross.

During the Army’s peninsular campaign in Tidewater Virginia, Olmsted commanded a fleet of ragtag steamboats that served as floating hospitals, picking up wounded soldiers and freighting them out of harm’s way.

But it was a constant bloodless conflict with the Sanitary Commission’s board that wore him out. He resigned as another administrative challenge lured him to California. (Olmsted later resumed his involvement with the Manhattan park. It would run in an on-again, off-again fashion for more than a decade. Predatory politicians meddled with his work, but in the long run, the Olmsted-Vaux design prevailed. Despite a number of intrusions, the park today still reflects their vision.)

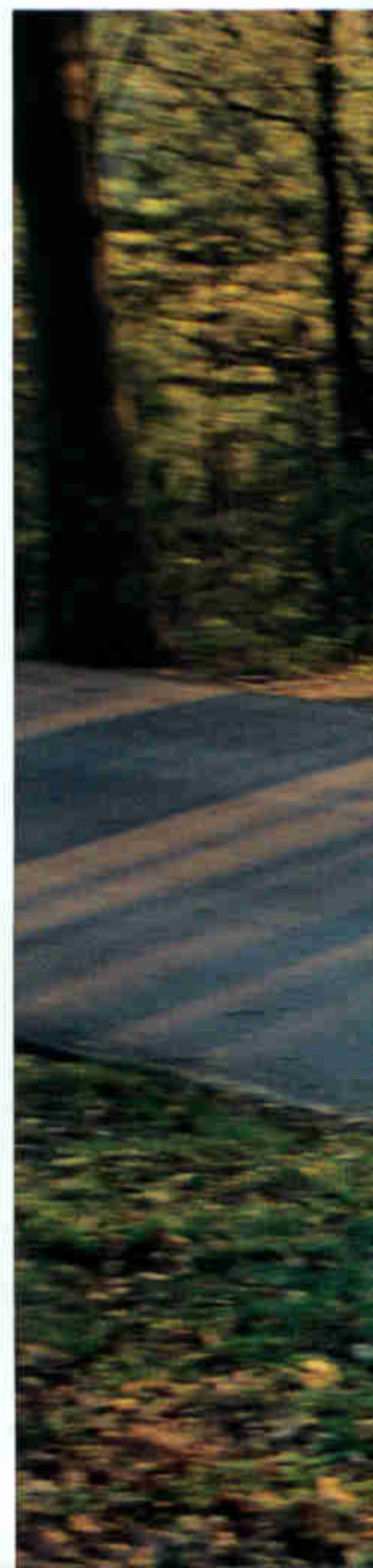
The Planner

Late in 1863 Olmsted accepted an offer to become manager of a congeries of gold mines in California. Spread across 70 square miles in the western foothills of the Sierra Nevada, the enterprise went through some hard

PARKS FOR THE PEOPLE

Prospect Park, Brooklyn, New York • Iroquois Park, Louisville, Kentucky

Olmsted, who created areas for musicians and pathways for strollers, would have approved of Drummer’s Grove in Prospect Park (below) and daredevil cyclists on the carriage roads of Iroquois Park.



times, and its new owners hoped this seasoned administrator—however inexperienced in mining matters—might stanch their losses.

This was a prickly venue for an Easterner who liked his landscapes green and glistening. A long drought had savaged the California countryside. The scrub-covered hills sat powdered with brown dust. From his headquarters at Bear Valley, Olmsted could look northeast toward more verdant elevations. And soon he'd be riding that way himself, first to a grove of giant sequoias—"the grandest tall trees you ever saw"—and finally into a lush valley bracketed by towering cliffs. Curiosity had introduced Olmsted to Yosemite.

He was not the first landscape aesthete to discover the glories of that magical place. Carleton Watkins, the stereoscopic photographer, had already set up his tripod in Yosemite Valley, and Albert Bierstadt, with palette, was not far behind. Unbeknownst to Olmsted at the time of his own first visit, the works of Bierstadt and Watkins had recently inspired Congress to

enact a measure transferring the valley and the Mariposa Big Tree Grove to the state of California, to hold in trust for the entire nation as a place "for public use, resort and recreation." President Abraham Lincoln signed the act in June 1864. Three months later the governor of California appointed Olmsted chairman of the Yosemite Commission, impaneled to draft a management plan for the country's first de facto national park. (In 1872 Yellowstone became the first official national park; Yosemite was not designated a full-fledged national park until 1890.)

In his report, drafted for the California legislature, Olmsted praised Yosemite not so much for the sharp relief of its cliffs and waterfalls as for the way the "wondrous heights" were "banked and fringed and draped and shadowed by the tender foliage of noble trees." He admired the Merced River "rippling over a pebbly bottom" and much preferred the meadows when wreathed in a "light, transparent haze."

"The first point to be kept in mind then," Olmsted insisted, "is the preservation and



AN URBAN ISLAND

Jackson Park • Chicago, Illinois

maintenance . . . of the natural scenery.” Yet for all its graceful logic, the document never reached the legislature. Calvert Vaux had persuaded Olmsted to return to New York to help design a new park in Brooklyn, and, in his absence, three of the Yosemite commissioners scuttled his plan.

The Artist

In later years, even after his talented hand had touched the landscapes of a score of major projects, Frederick Law Olmsted confessed that he was prouder of Brooklyn’s Prospect Park “than of anything.” He had good reason to be, for most assessors of his and Vaux’s collaborative designs tend to rank this place as the partners’ most beguiling work. Moreover, the park’s very name had the ring of promise and hope about it. Here, after so many distractions, was the pivot—the “hinge,” one biographer called it—on which Olmsted could swing back to the career that would challenge him for the rest of his life.

In designing Prospect Park, the organizing principle was simple enough: Provide the visitor with “a sense of enlarged freedom” by restricting the intrusion of architectural distractions. Parkways would radiate into other parts of Brooklyn, inviting access, but once inside the park, the visitor would find its borders mounded up and densely planted to shut out the city beyond. Grass, woods, and water were to define the park’s interior, one element leading on to the next: First, the Long Meadow, an undulant pasture (and long by a mile), “its turf lost in a maze of the shadows of scattered trees”; then a forest skewered by a brook cascading through a leafy ravine; and finally a 60-acre lake built on the outwash plain of an ancient glacier.

Olmsted was ambivalent about embracing the presumptive role of artist. “I don’t feel strong on the art side,” he informed Vaux before tackling the Brooklyn collaboration. But Olmsted was only kidding himself, for he had already described Central Park as his canvas. “My picture is all alive,” he boasted. “Its very essence is life, human & vegetable.”

Olmsted turned swampland into a dramatic setting for the 1893 World’s Columbian Exposition in Chicago. Dredged lagoons provided drainage and boat rides and created the Wooded Island, now a quiet counterpoint to the Windy City.

The Park Maker

It was surely fortuitous that the man who introduced the practice of landscape architecture to America should come along at a time when its aging cities discovered they needed parks to let in some fresh air. Olmsted helped frame that discovery against the postwar emergence of a frontier more perilous and barbaric than that of the Wild West. The new frontier was eastern and defined by the crowding, the stagnation, the industrial morbidity of urban America in the latter half of the 19th century.

In tandem with Vaux, or without him after dissolving the partnership in 1872, Olmsted increasingly found his talent for designing parks much in demand. Buffalo was one of the first cities to seek his advice. Before long he was busy launching three of his most notable projects,





each one eventually completed basically as he designed it—a park system for Boston, a mountain park for Montreal, and a parklike design for the grounds of the U.S. Capitol in Washington. For the Capitol he prescribed curvilinear walks among specimen trees and a new marble terrace flanked by matching grand staircases. In Montreal he left Mount Royal's features pretty much as the glaciers had fixed them. "It would be wasteful," he declared, "to try to make anything else than a mountain of it." And for Boston he created an Emerald Necklace that would reach, via connecting parkways, from the Common and Public Garden at the foot of the State House all the way to Franklin Park.

In subsequent years Olmsted parks or park systems would be in the works in Bridgeport, Connecticut; Rochester, New York; Wilmington,

Delaware; Baltimore, Detroit, Chicago, and Milwaukee. Three of his most charming parks would be opening in Louisville, each named to honor a tribe—Cherokee, Shawnee, and Iroquois—that once had shared the dark and bloody hunting grounds of Old Kentucky.

The Architect in Chief

The Frederick Law Olmsted National Historic Site is located at 99 Warren Street, Brookline, Massachusetts, in an 1810 wood-frame farmhouse handsomely perched on a two-acre lot. The house and an office wing contain the Olmsted Archives, a collection of hundreds of thousands of plans, drawings, planting lists, lithographs, and photographic prints that document the creative energy of this self-taught man and his professional heirs over the



MOUNT ROYAL PARK, MONTREAL, CANADA



PROSPECT PARK, BROOKLYN, NEW YORK

ESSENTIAL ELEMENTS

Land, water, trees became "successive incidents of a sustained landscape poem."



DELAWARE PARK, BUFFALO, NEW YORK



CHAPIN PARKWAY, BUFFALO, NEW YORK

Olmsted wanted his parks to change with the seasons while still drawing the eye to visual delights: a curving lake in Montreal, a rustic gazebo in Brooklyn, a mighty oak or broad parkway in Buffalo. He was convinced that natural beauty could improve human nature.

THE LONG VIEW

Biltmore Estate • Asheville, North Carolina

years. The archival abundance here can overwhelm you, unless you have already dropped by the Library of Congress, where the architect's paper legacy occupies shelf space the linear equivalent of a football field.

Olmsted had moved from New York to Boston's most distinguished suburb in 1881 and later purchased the farmhouse he called Fairsted. It served as both office for his busy firm and home base for his extended family—wife Mary, their two children, and her own three from a previous marriage to John Hull Olmsted, Frederick's brother and dearest friend who had died, age 32, while Frederick was starting to tackle the challenge of Central Park. Two of the children—John Charles and Frederick Law Jr.—would come of age as full partners in the firm and carry its work well into the 20th century.

By the 1880s Olmsted's accumulating ailments were beginning to take their toll. He suffered from chronic insomnia. A twice-injured leg had forced him to take up a cane. Periodic bouts of depression plagued him. At the same time, according to his most definitive biographer, Laura Wood Roper, he was carrying "a heavy burden of professional works, some of staggering complexity. . . . There was a curious disparity between his passion for the contemplative enjoyment of scenery and his compulsion to work to his utmost limit."

Two works in particular challenged Olmsted in the final decade of his life—George Washington Vanderbilt's great estate, Biltmore, near Asheville, North Carolina, and a design for the World's Columbian Exposition at Chicago in 1893.

For Olmsted, the grounds of the Columbian Exposition were familiar territory. With Vaux, some 20 years earlier, he had drafted a plan for a thousand-acre pleasuring ground in Chicago—Jackson Park on the lakeshore, Washington Park on prairie land to the west, and, connecting them, a broad greenway called the Midway Plaisance. The Chicago fire of 1871 had delayed that scheme, but now Jackson Park, with its inner lagoon and lake views, and part of the Midway were up and running as the site of the fair.

Olmsted's vision for the fair was by far his most daring and exotic. To offset the overpowering,

The Biltmore Estate was one of Olmsted's finest landscapes and included a six-acre lagoon that reflects the majestic house. Here, frail and nearing 70, he wrote a friend: "I have raised my calling from the rank of a trade . . . [to] an Art, an Art of design."

almost blinding, effect of the exposition's massive white buildings (newspapers referred to the fairgrounds as the "White City"), he insisted on dense displays of luxuriant foliage; 75 railroad flatcars were needed just to deliver his order for aquatic plants. And to give the lagoon eye-catching cachet, he called for a fleet of birchbark canoes with Native American paddlers, in deer-skins, darting among flotillas of Chinese sampans and "Esquimaux kiacks."

But his time was winding down. He was getting forgetful. He was obliged to leave the important work to others. He wrote to a friend that he feared he might be institutionalized in an asylum, and it wasn't long before he was.

Frederick Law Olmsted died at the McLean Hospital at two o'clock in the morning of August 28, 1903. He was 81.





Nineteen-aught-three was not a happy year for some of the men who had ensorcelled the world with their pictures. Death had taken James Abbott McNeill Whistler and Paul Gauguin earlier in the year, and Camille Pissarro, a master Impressionist, would be dead in a few months. Their legacies are imprinted broadly, but mostly on canvas. Olmsted's are engraved in the land.

I was reminded of those long-gone canvas painters one warm spring day when I stopped by Central Park to see how the 72nd Street Boat-house had been transformed into an elegant bistro from its dereliction in earlier days. I sat at a table outdoors overlooking the sun-dappled lake—in the distance Vaux's Romanesque Terrace on one side, Olmsted's bosky Ramble on the other, the boaters in their rented skiffs gliding back and forth, in between. I felt as if I were

viewing an Impressionist painting of the finest quality. *Sunday in the Park with Fred*. And I recalled the words of the architect Daniel Burnham, who had served as the Columbian Exposition's general manager and, raising a toast to honor Olmsted at a banquet the old man could not attend, said: "As artist, he paints with lakes and wooded slopes; with lawns and banks and forest-covered hills; with mountainsides and ocean views. He should stand where I do tonight, not for his deeds of later years alone, but for what his brain has wrought and his pen has taught for half a century." □

OASIS IN THE CITY Frederick Law Olmsted's majestic contributions continue to inspire awe and offer respite to city dwellers. Witness the beauty of his landscapes at nationalgeographic.com/magazine/0503.

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EXPLORATION

FIELD DISPATCH PERU



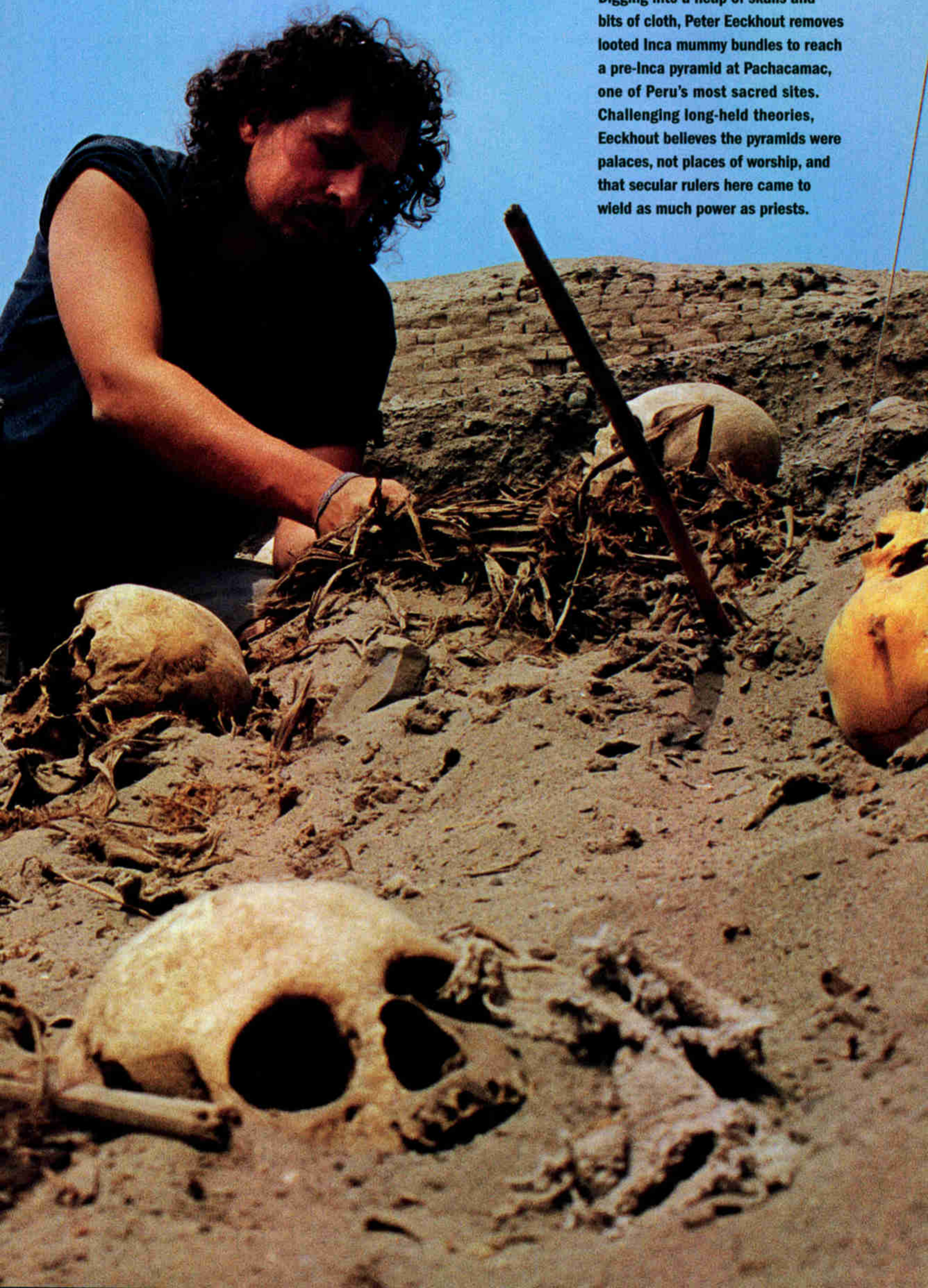
Ancient Peru's Power Elite

GRANTEE

Peter Eeckhout
Archaeologist
Free University of Brussels,
Belgium

"Working with preliterate peoples, you are on a thin rope. The people are dead, and time machines don't exist."

Digging into a heap of skulls and bits of cloth, Peter Eeckhout removes looted Inca mummy bundles to reach a pre-Inca pyramid at Pachacamac, one of Peru's most sacred sites. Challenging long-held theories, Eeckhout believes the pyramids were palaces, not places of worship, and that secular rulers here came to wield as much power as priests.



Preserved from tangled hair to toes, the intact mummy of a pre-Inca woman lay under the A.D. 1000 foundation of a temple Eeckhout found near the pyramids.

By Peter Eeckhout
Photographs by Mauricio Mergold

The dead are beginning to tell tales at Pachacamac, a sprawl of ruins and graves near Lima, Peru.

First settled around A.D. 200, Pachacamac became one of the longest continuously inhabited urban centers in the Andes, enduring and even thriving under various cultures for some 1,300 years. Named for the creator god Pachacamac, the site drew pilgrims who came to worship and to bury their dead. Over-taken by the Inca around 1470, it was one of the most sacred places in their empire until the Spanish conquest in the 1530s.

When archaeologists began exploring the site in the 1890s they found a vast complex of monumental buildings and looted burials. At its heart lies an enigma: 18 mud-brick stepped pyramids with ramps and plazas. In 1993 I began the first comprehensive excavation of one of these structures, which dates from the late 1300s to mid-1400s. After more than a decade of digging I've found





THE PROJECT

PACHACAMAC: One of the longest occupied cities in the Andes and one of the three most sacred sites in the Inca Empire

COMPARED TO: Mecca, Delphi, and the Vatican

BURIALS: An estimated 80,000

LOCATION: Just south of Lima

SIZE OF THE SITE: Buildings and burials cover about 400 acres; artifacts found over 1,200 acres



evidence that is shining new light on the meaning of the pyramids—and overturning old assumptions.

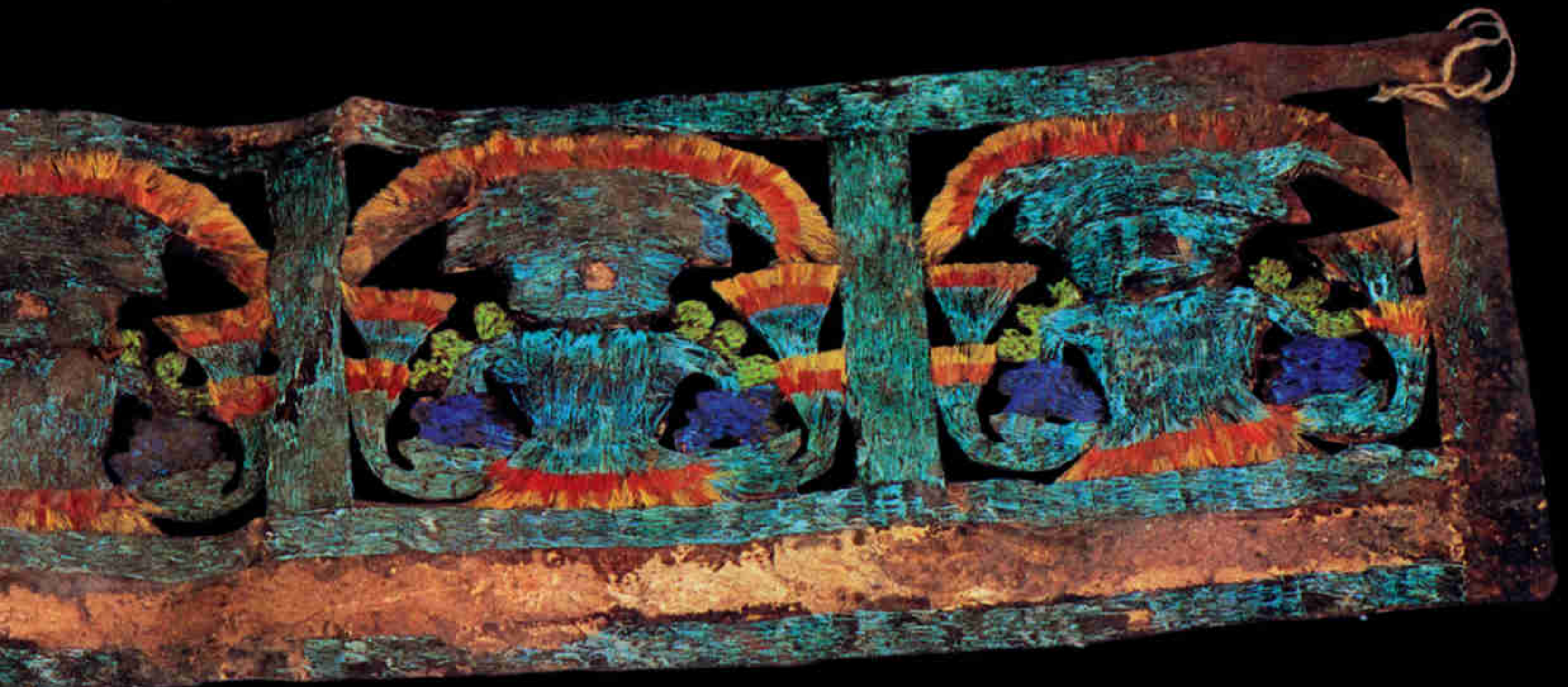
For decades most scholars thought the pyramids were religious “embassies” that housed delegations from far-off communities who came to worship, bring tribute, and make offerings to Pachacamac. I expected to find evidence supporting this theory: ornate building designs suggesting religious use, the remains of plentiful offerings, nonlocal artifacts, and signs that the pyramids were occupied simultaneously by groups from across Peru and beyond.

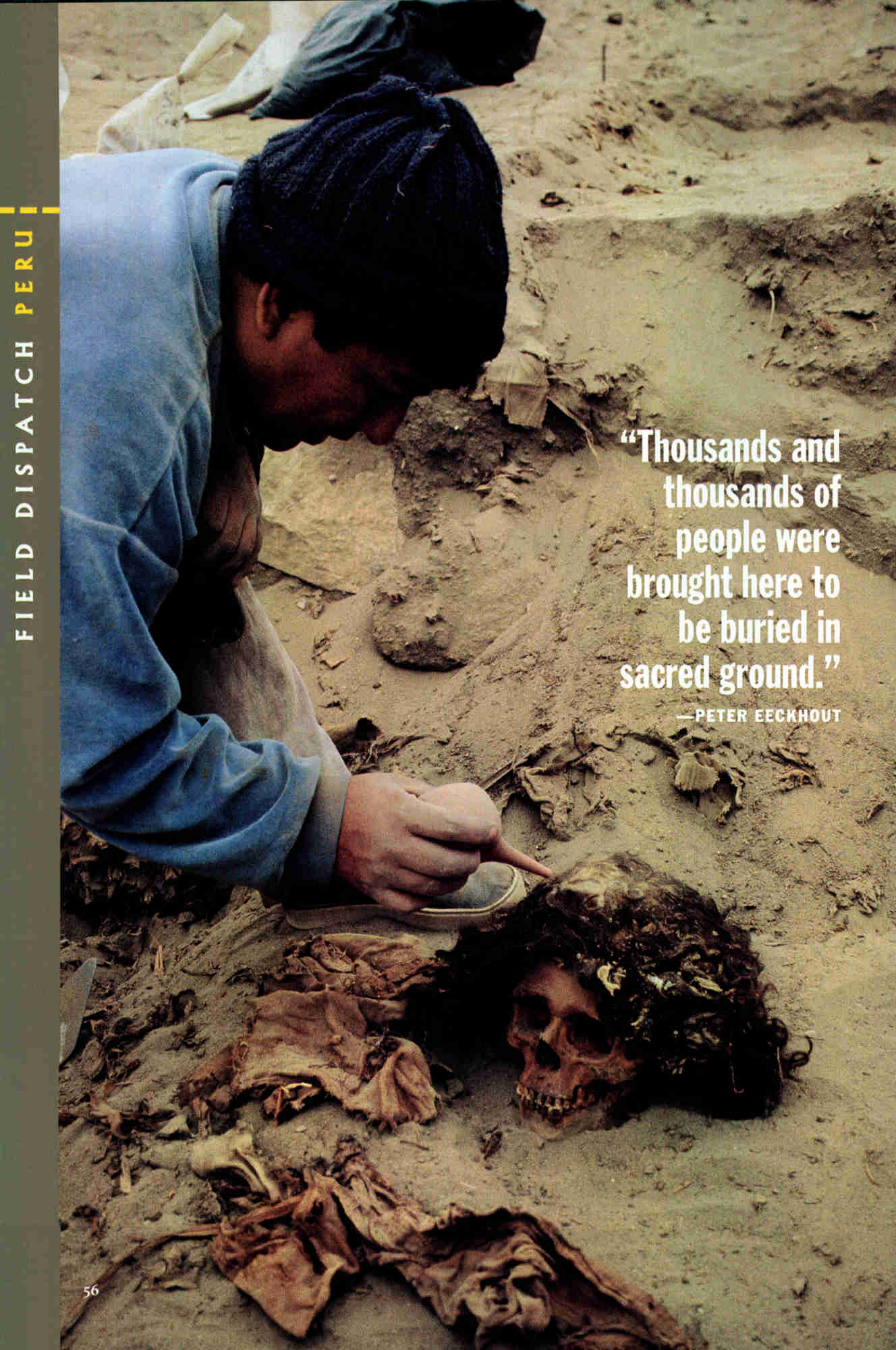
Instead, my team and those

who had previously dug at two other pyramids have uncovered buildings that in their layout and lack of adornment resemble secular Andean palaces rather than religious centers. Rooms held the remains of textiles and guinea pigs (a common food), suggesting domestic chores such as weaving and raising animals. We found few nonlocal artifacts. And the offerings we discovered (including a human baby) were clearly placed in the pyramids at the time of their construction or ritual abandonment. At that point the floors were covered with a fine layer of sand, and selected chambers were filled



The headdress of a pre-Inca chief (below) bears the image of a coastal god of fertility and death (detail at top), delicately worked in feathers from the Amazon. A feathery fan (above) gives a glimpse of life in the palace of a local lord.



A man with dark hair, wearing a blue long-sleeved shirt, is kneeling in a sandy, excavated site. He is looking down at a human skull that is partially buried in the sand. The skull has dark, curly hair attached to it. The man's right hand is near the skull, and he appears to be examining it. The ground is sandy and contains some debris, including pieces of wood and fabric. In the background, there are more excavated areas and some dark objects, possibly bags or equipment.

“Thousands and thousands of people were brought here to be buried in sacred ground.”

—PETER EECKHOUT



with mummies and riches, then sealed off. Most important, radiocarbon dating suggests that the pyramids were not occupied at the same time, as embassies would have been, but one after another in successive periods of about 30 years—the average length of a ruler’s reign.

I can only conclude that the pyramids were palaces of the Ychsma (EESH-ma) lords who ruled Pachacamac and some of its surroundings during what archaeologists call the Late Intermediate Period (A.D. 900 to 1470). At each lord’s death he would have been buried with his spouse, concubines, and servants, his palace turned into a tomb where his mummy could be worshipped. His successor then built a new palace nearby.

Historical records support this conclusion. The chronicler Blas Valera reported just such a tradition in the 1580s, likely a remnant of earlier, pre-Inca

Much of Pachacamac’s 1,300-year history lies hidden under Inca-period burials: An excavator blows sand off the hair of an Inca mummy (left), and a lobsterlike beast (top) stares from a shroud. Eeckhout (right, at center) and his crew examine textiles from looted mummy bundles.

customs: “After the death of the king or lord . . . they would place the deceased in a bedroom or chamber ready-made for him . . . and wall up the door and windows. . . . The halls, portals, wings, and other rooms . . . were kept open so that [people] could enter and pray.”

The idea that the pyramids were palaces matches a model developed independently by archaeologist William Isbell for the pre-Inca sites of Huari and Conchopata in the central highlands of Peru. Still, this interpretation remains controversial. The widely held embassy theory often has been used to explain the rise of monumental sites all

over the Andes as religious centers ruled by priests. If excavations at Pachacamac show that its core was filled not with religious monuments but with the seats of secular rulers, then power in ancient Peru may have been shared by lords and priests to a far greater degree than was previously thought.

Peru’s preliterate peoples cannot speak to us directly. But they’ve left tangible clues to their civilizations. It’s up to us to listen to their voices. □

DIG FOR CLUES To learn more about the ruins of Pachacamac, see resources and a bibliography at nationalgeographic.com/magazine/0503.



Off Ireland's Skellig
Rocks, gray seals
materialize in murky
waters, peering
from thickets of kelp
before vanishing
into the blue.

HALICHOERUS GRYPUS

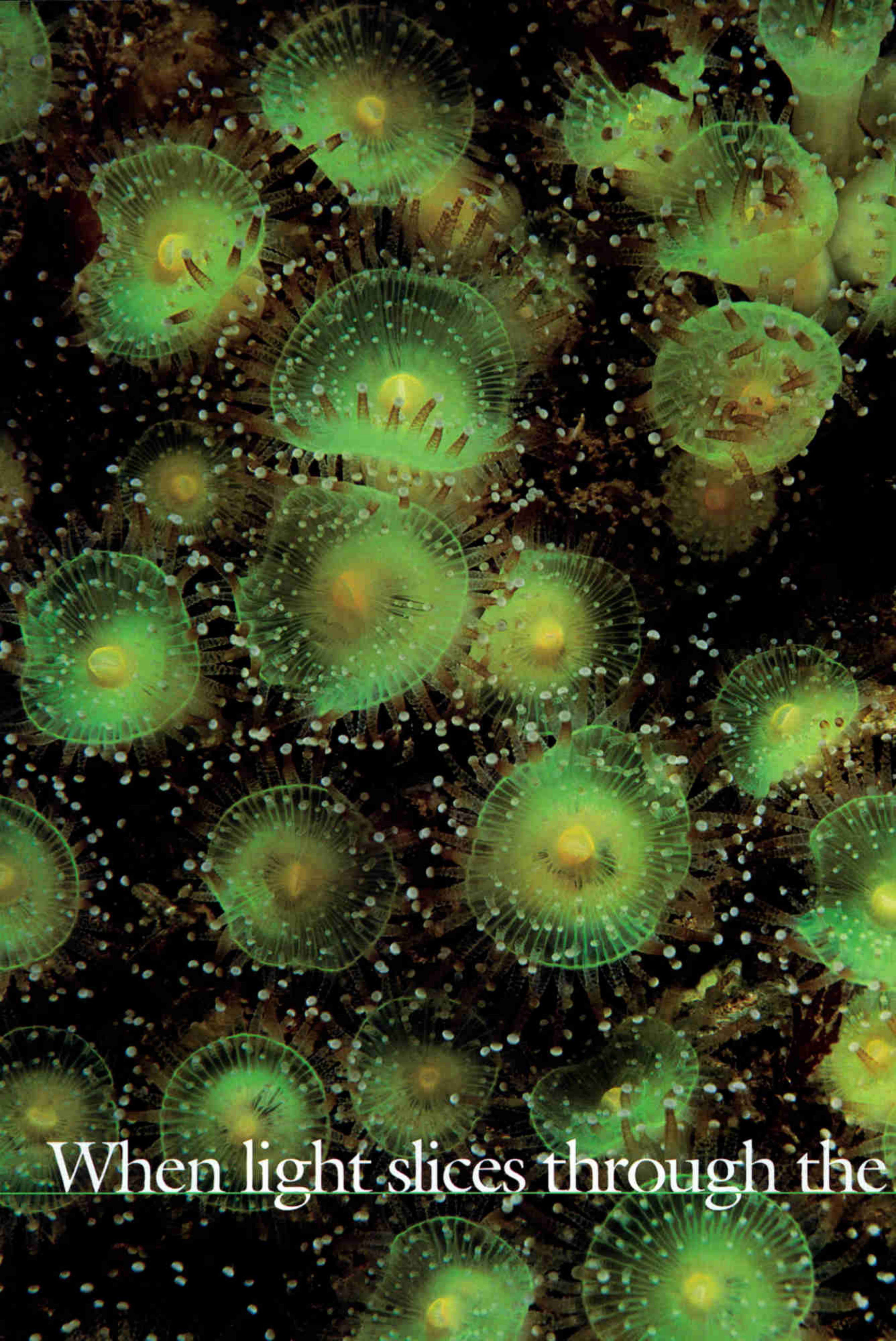


Celtic legend speaks of *selkies*, seals that shed their pelts and walk ashore as humans. Reality can be just as magical where warm currents nourish life


beneath Irish isles

By Jennifer S. Holland NATIONAL GEOGRAPHIC SENIOR WRITER

Photographs by Brian Skerry




When light slices through the



Neighboring colonies of jewel anemones bedeck bland stone in positively tropical hues. Pink tentacles retreat like fingers into a fist as a painted topshell snail (below) sweeps edibles from one vivid patch.

ANEMONES (*CORYNACTIS VIRIDIS*);
SNAIL (*CALLIOSTOMA ZIZYPHINUM*)

sea, life sparkles like
a city at night.

An aerial photograph of the Kerry coast in Ireland. The image shows a dramatic coastline with layered, grey rock formations that appear to be 'stony toes' protruding into the dark blue Atlantic Ocean. The rocks are characterized by distinct horizontal strata. In the background, a green, rolling landscape with some buildings and a body of water is visible under a clear blue sky. The overall scene is rugged and scenic.

The stony toes
of the Kerry coast
prod the Atlantic
on a clear Irish
afternoon. The
trick to Ireland's
diverse marine
riches: a complex
mingling of tides,
temperatures, and
topographies.



above a cold, swollen sea, a sunny day gives way as clouds wrap the sky in silver gauze. Rain, as always, is coming. The boat slaps a drumbeat as we motor from Valentia Island, just off Ireland's southwest coast, toward the stone teeth of unnamed isles farther offshore. Bogged down by weights and a cumbersome dry suit with its puzzle of hoses, I can't bend to put on fins, so one of our four-diver crew does it for me. Approaching the 300-foot rocky sky-rises, the pilot throttles down, and I am escorted to the boat's edge, the waves bucking below. When the sea calms for a moment, I press my mask to my face, breathe shakily into the regulator, and jump. Diving is hardly a typical pursuit in the Emerald Isle, where leaden skies, serrated

An intentionally donned seaweed cap fails to disguise a scorpion spider crab in motion. Thousands of invertebrate species help weave the Irish Atlantic's extensive food web, which springs from flourishing plankton and algal communities along the coasts.

INACHUS DORSETTENSIS

shorelines, and soggy velvet hills tend to send visitors crawling to the nearest pub. What incentive could there be to skip the frothy pint and splash into a stretch of Atlantic sure to be skeleton cold and nearly as lifeless?

In a word, surprise. Sinking beneath the swells into 52-degree water, I'm floored by anemones that gleam as pink as bubble gum, as green as a lime snow cone, so orange I can almost taste the juicy pulp. Flatfish with their eyes topside wear mottled camouflage so spot-on that they hide in plain sight. Childlike gray seals nibble another diver's fin before rocketing out of reach. Their home, the Skelligs, is a pair of drip castles of red sandstone frosted with guano and feathered with thousands of gannets and puffins. The larger isle, Skellig Michael, rises over 700 feet above water and plunges another 160 below, merging with the continental shelf. To dive at the kelp-covered base of this rock with the legendary *selkies* as companions, then ride my exhaled bubbles to the surface, is a rare privilege.

It's a pair of warm flows—the North Atlantic Current from the Caribbean and the Shelf Edge Current from Portugal and France—creeping up Ireland's west and, indirectly, east coasts that keep winters and waters relatively mild and stable, a boon for marine life. Where I dove on the western side, animals, many at the extremes of their ranges, meet in clean temperate Atlantic waters that wash shores of varied rock types and topographies from exposed cliffs to sheltered coves. Habitats, as a result, are assorted and ample in the intertidal zone and on down the gently sloping shelf. Life explodes into every niche.

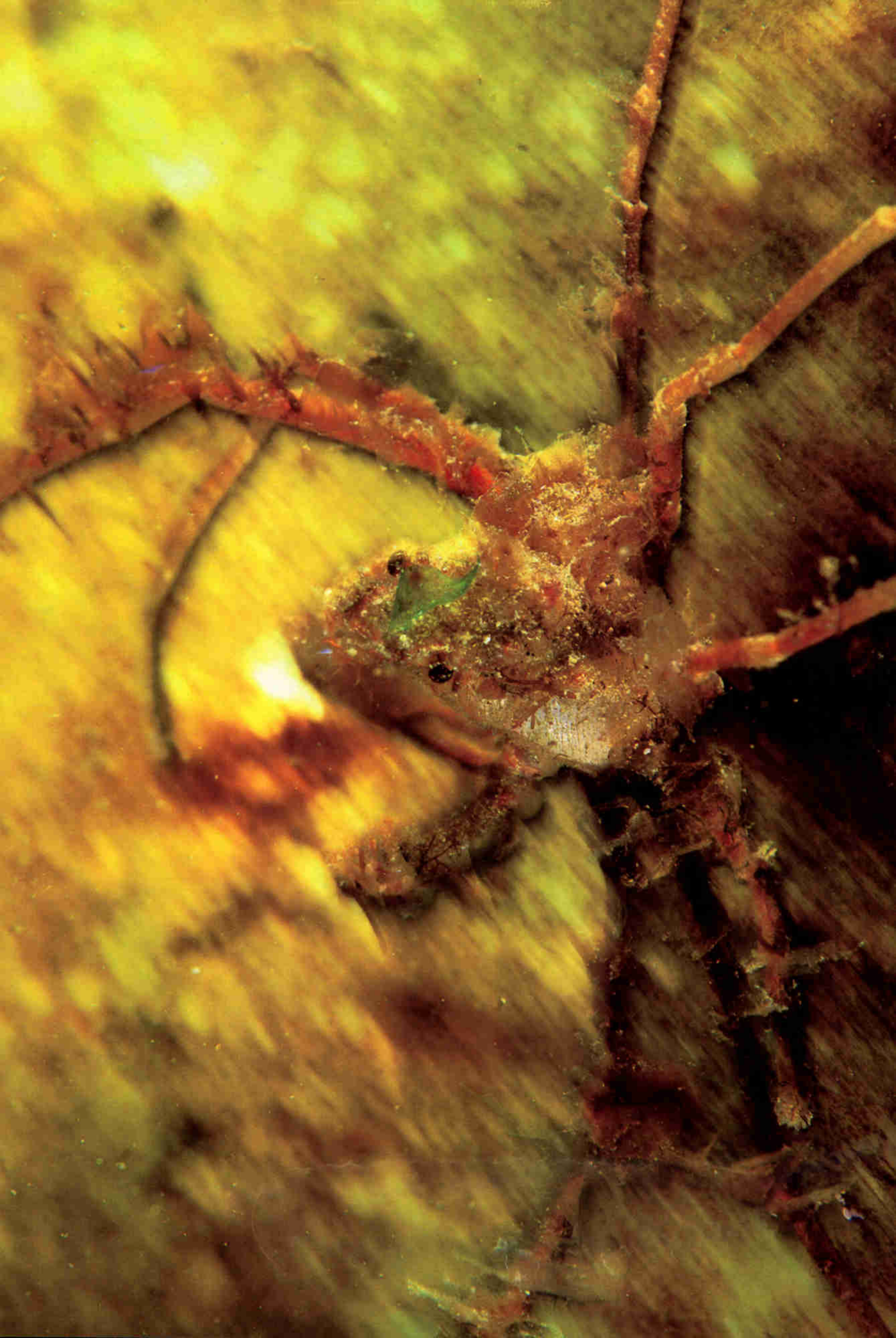
It doesn't take a deep dive to witness the sea's plenty. The walls of Valentia pier awaken at sunset: Busy invertebrate legs twitch and wave as animals skitter about, dancing in place or scrambling up vertical stages. Eye stalks mark time—poking out, drawing back, out, in. Crabs hoarding jellyfish scoot with clawfuls into crevices.

In a plankton haze 20 feet down, I move with slow kicks to the muffled clacking of shells and claws against bedrock bones.

On walls in deeper waters, gaudy anemone carpets give way to pan-size starfish and colonies of orange soft corals called dead man's fingers, which shoot out feathery white antennae to feed. A dogfish shark curls into a comma under my flashlight's glow; blennies raise eyebrows and giant conger eels poke heads, puppetlike, from the grottoes. (Much deeper and out of my reach, at nearly 2,000 feet, lies a recent scientific discovery: cold-water coral gardens in a barely explored environment.) On my reluctant ascent I run a gloved hand through slippery kelp whips that nod in the current. Suddenly something pierces the sea surface and whooshes down in a stream of bubbles, stopping to eye me before beating a frantic departure. It's not a fleeing fish but a bird called a guillemot seeking a seafood meal—a fellow ocean visitor as astounded as I by creatures so unexpected.



A VIRTUAL DIVE Take the plunge with photographer Brian Skerry and experience the Sights & Sounds of Ireland underwater. You can also see more of his images, download wallpaper, or send a postcard to a friend by visiting nationalgeographic.com/magazine/0503.



In pink chiffon,
a jellyfish pulses
through shallow
water off the Aran
Islands. Thumb-
size whiting ride in
tow, gulping plank-
ton stirred up by
the jelly's move-
ments. The whiting
dodge the jelly's
venomous tendrils
but stay close
enough to gain
protection from
large predators.

JELLYFISH (*PELAGIA NOCTILUCA*);
WHITING (*MERLANGIUS MERLANGUS*)







STARFISH (*ASTERIAS RUBENS*); DAHLIA ANEMONES (*URTICINA FELINA*); DEAD MAN'S FINGERS (*ALCYONIUM DIGITATUM*)

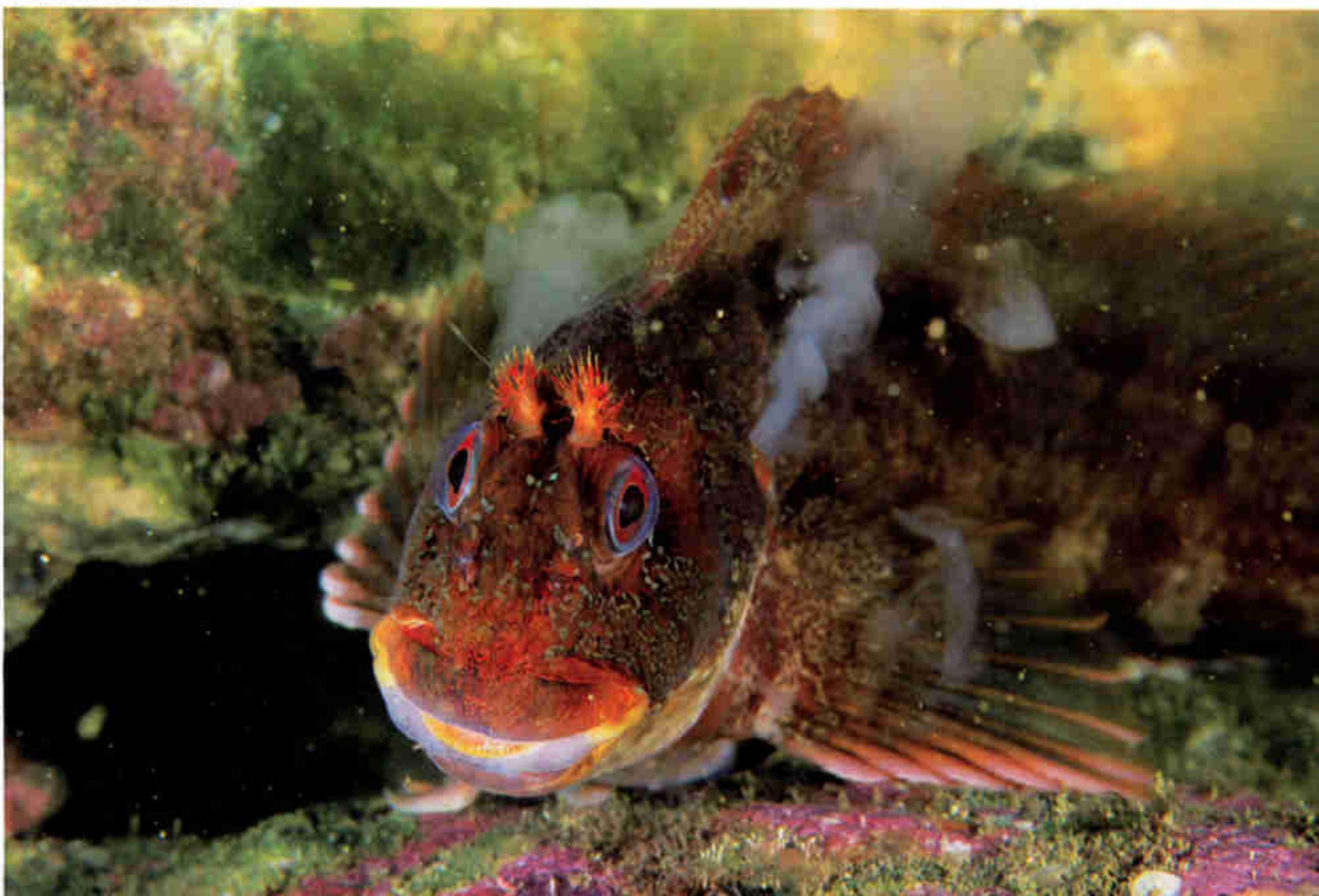


SEPIOLA ATLANTICA

Three acts of life

Elemental needs lead to remarkable displays. Investigation (left): Starfish on the hunt among dahlia anemones embrace a guillemot egg that tumbled from its nest, a rock ledge jutting over the sea near Valentia. Once the egg cracks, stars and other bottom dwellers will devour its soft filling. Consumption (below): A tompot blenny makes short work of its lunch—likely a clam, snail, or barnacle—sending fine bits of shell puffing like smoke through its gills. Reproduction (above): Known as little cuttlefish, these inch-long squid relatives mate in open water off the Aran Islands, the male's arms tucked into the female's mantle to deposit a sperm packet. The iridescent creatures communicate with shifting patterns and colors and, if threatened, squeeze off shots of ink to mask their getaway.

PARABLENNIUS GATTORUGINE



A topsy-turvy meeting with a gregarious dolphin makes for a fond Irish farewell. "Weather and water conditions here can be tough," says diver Nigel Motyer, below, "but those moments of clarity, those wild encounters, are great rewards." □

TURSIOPS TRUNCATUS

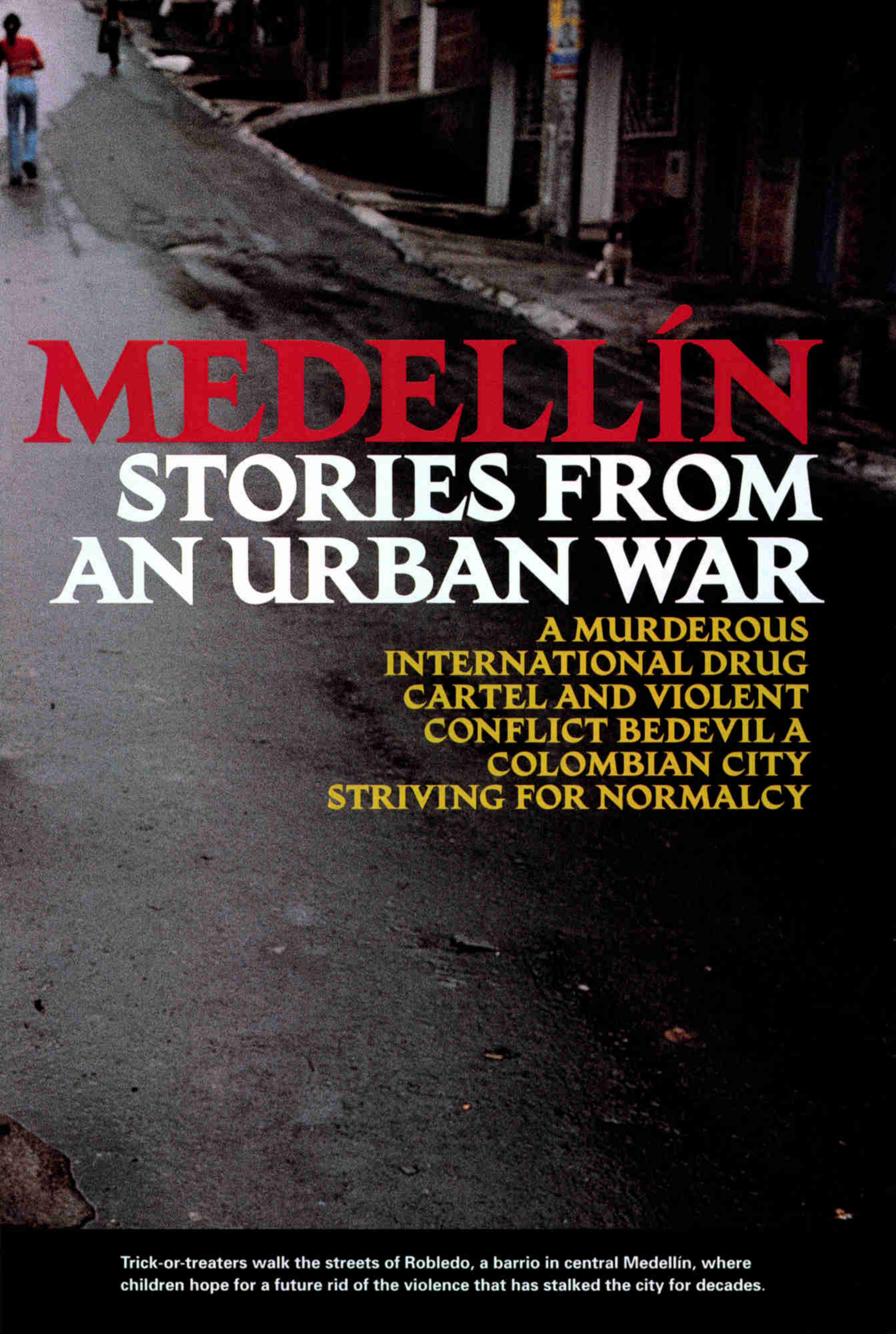


At every graceful turn this



emerald world will
steal your heart away.





MEDELLÍN **STORIES FROM** **AN URBAN WAR**

**A MURDEROUS
INTERNATIONAL DRUG
CARTEL AND VIOLENT
CONFLICT BEDEVIL A
COLOMBIAN CITY
STRIVING FOR NORMALCY**

Trick-or-treaters walk the streets of Robledo, a barrio in central Medellín, where children hope for a future rid of the violence that has stalked the city for decades.



**A HIVE OF DRUG DEALERS,
PARAMILITARIES, AND REBELS**



One of 5,000 inmates, Nelson Betancour Hernández says he's in the grossly overcrowded Bellavista Prison for violating *Ley 30*—the law against narcotics trafficking.

BY ELIZA GRISWOLD

PHOTOGRAPHS BY MEREDITH DAVENPORT

How do people live here? I ask myself, panting, climbing up stairs carved into the wall of the impossibly steep Andean valley. It's 6 p.m., and below me clusters of lights are just coming on as Medellín's yuppies

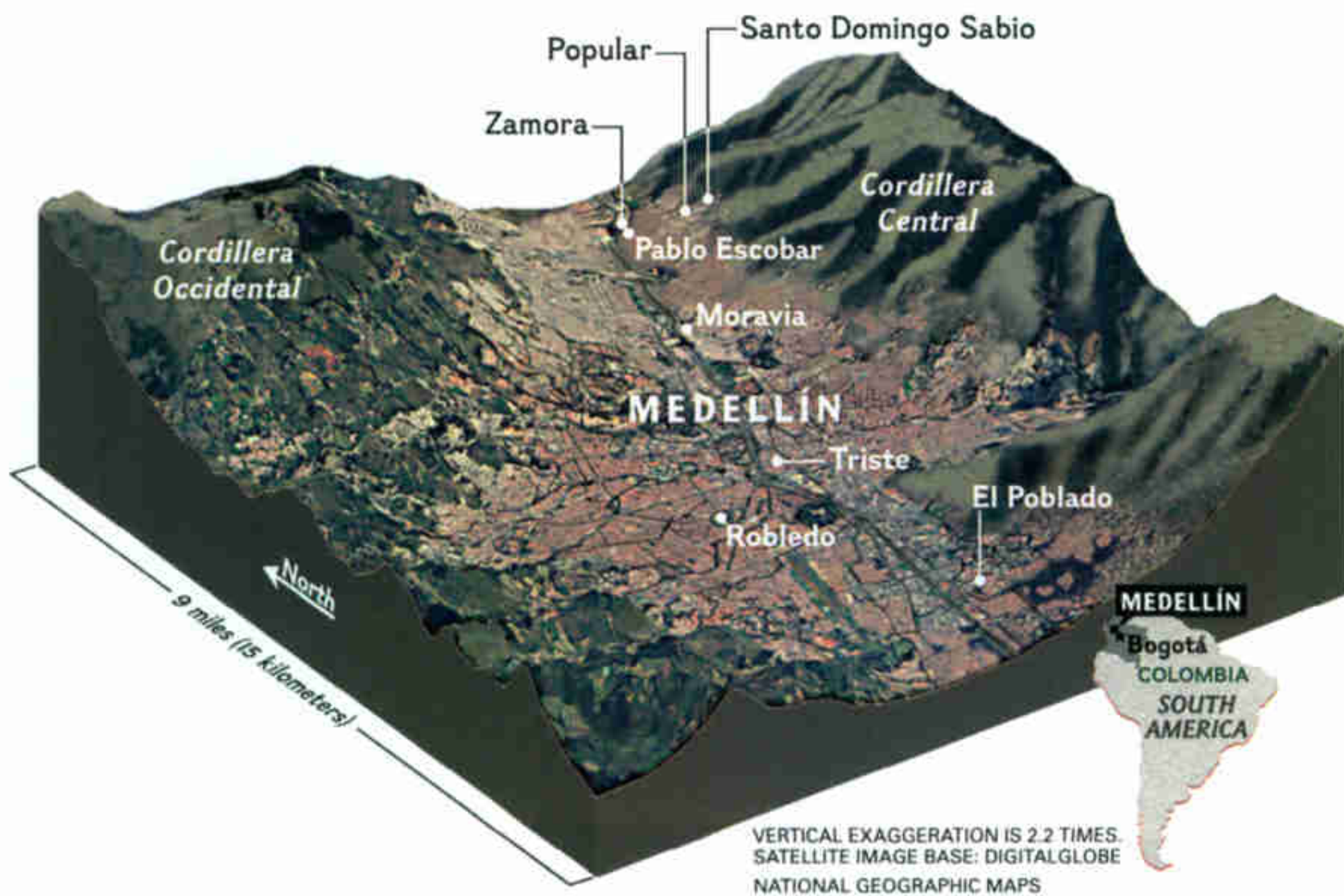
(pronounced JOO-pees), who live along the valley floor, return from work to their gleaming high-rises. But up here, among the pirated power lines and the makeshift shacks clinging to the hillside, is the other Medellín, where about 65 percent of the city's three million people live in a world patterned by violence.

Most of Medellín's poor are from the surrounding countryside, which they fled to escape Colombia's 60-year-old civil conflict. That clash

began as a struggle between poor campesinos and wealthy landowners in the 1940s, but it grew (especially after the drug trade expanded in the 1970s) into a savage free-for-all that eventually spread to Medellín, Colombia's traditional center of textiles and entrepreneurship.

Until recently the city was notorious, known as both the murder capital of the world and as the home of drug kingpin Pablo Escobar, who ran the Medellín cocaine cartel for years and poisoned the city with his army of *narcotraficantes*, drug dealers, crooked cops, and assassins. Escobar was gunned down on a rooftop by police a decade ago, but his legacy is everywhere, from Barrio Triste—the downtown “neighborhood of sadness” known for the glue-sniffing ghosts who haunt its alleyways—to El Poblado, the fancy, high-security mall land to the city's south.

Throughout the city, local people, called *paisas*, live in a world in which right-wing paramilitaries have wrested violent control from clashing street gangs and left-wing guerrillas, and where death has become a way of life. But the real story of Medellín is not how people die, but how they survive—with a unique paisa blend of humor and despair, and sometimes even hope.



Pride of Medellín, Colombia's only metro system (opposite) cuts through a troubled but vibrant city. Rising above the gothic gingerbread of the old government palace, high-rise buildings show a prosperity undergirded by the textile, coffee, cement, and banking industries. Beyond the downtown core lies a sprawling metropolis of more than three million people (map).



THE COP

When I first met the woman I'll call María T., 42, she hadn't left the house together with her two young daughters, ages 11 and 9, in more than six months because of death threats. When her first daughter was born, a bodyguard had to bring María home from the hospital since it was too risky for her husband to drive her. Pablo Escobar had put a price of five million pesos (about \$7,000 at the time) on the head of every honest cop in Medellín, and many were being hunted down and murdered. These days, María is under heavy guard because of her role in busting Medellín's "narco-terror" rings—armed groups of both left-wing guerrillas and right-wing paramilitaries who traffic in drugs and operate cells within the city. It's always something, she says with a shrug over coffee in the police cafeteria.

Armed with a .45 pistol and a law degree, María works as a *fiscal*, a kind of Colombian super-cop who functions as a combination police officer, investigator, and prosecutor. Hundreds of cases cross her desk every year, most of them related to the cocaine trade, a multibillion-dollar-a-year business.

One of the highest ranking cops in Medellín, María is very good at what she does. She's also incorruptible. These qualities have earned her a

number of promotions during her 20-year career—and some very dangerous enemies. To stay ahead of the *sicarios*, or assassins, María and her husband, a lawyer, have moved four times in the past three years.

On a typical weekday María gets her daughters dressed, feeds them breakfast, and sends them to school under the care of three armed guards. Then, wearing her gold necklace (which bears the likeness of María Auxiliadora, a.k.a. Our Lady of the Assassins, Medellín's de facto patron of killers, mothers, and anyone in need of protection), she climbs into an unmarked armored car with a phalanx of five bodyguards and goes to work. Once there, María might strap body armor over her white stretch pants and rhinestone belt and climb into a helicopter to raid some hidden drug lab in the jungle outside the city.

About a year ago, one of the gang kingpins María sent to prison told her she was a dead woman. This was nothing new. In the past 25 years more than 120 judges and fiscales have been assassinated in Medellín, and drug lords often order hits from jail. Once during a raid, María had found her name on a hit list hidden under a computer. But this time was different. Through an underworld informant, she learned

that a contract had been taken out on her life—and *paid*—which means the killers will be very difficult to deter. Two months before I met her, she learned that sicarios had arrived from the capital city of Bogotá to kill a “tough little lady cop.”

That’s why I’m surprised when after several interviews under high security, María suggests that we go to a local mall with her daughters and leave the bodyguards outside. She’s tired of prison-like vigilance, she says, and besides, I’ve asked to meet her daughters. After a series of phone calls, we rendezvous at a table in the food court.

Without bodyguards to keep watch, María’s eyes dart back and forth over my shoulder as if she’s watching a tennis match. I think of something I’ve learned but rarely remember: Never sit with your back to a door when speaking to someone who might get shot. María leaves us for a few minutes so that her daughters can speak with me privately, but they’re shy, and pressing them on the danger of their lives, or their mother’s, feels wrong. “We can’t ride our bicycles outside anymore,” the older one ventures. Her sister adds, “I’m proud that my mom catches bad guys and makes the city safe.”

María returns to the table. “When my oldest was really little, she said, ‘I want to be a fiscal like my mom,’” María says with a sad smile, “but now she wants to be a doctor like my sister.” I ask María what makes her job worth the ultimate risk. “I believe that if Colombia’s ever going to change, people have to be involved,” she says. Like many of Medellín’s heroes, María doesn’t look like anyone special. You might even say she’s hiding in plain sight.



UNTIL RECENTLY MEDELLÍN WAS KNOWN



An execution victim (above) adds to the grim toll run up by paramilitary gangs and leftist rebels fighting for control of Medellín’s barrios. Today the murder rate is falling as police work to disarm the combatants. Yet streets still brim with desperate children (left) who sniff glue and often die young.



AS THE MURDER CAPITAL OF THE WORLD

THE KILLER

The man I'll call Carlos R., 20, is exactly the kind of guy who'd be sent to kill María. Born in Medellín—and raised, like lots of kids here, without a father—Carlos left school in third grade after he split a kid's head open with the model of a church he'd built. (The boy had stolen Carlos's pencil sharpener.) After that Carlos collected scrap metal on the streets and later graduated to committing crimes. He saw his father several years ago; the man offered him an apple on the street, but Carlos refused it. "It would be better to kill this guy," Carlos tells me as we walk the streets of Barrio Triste, past

an array of mechanic shops and cocaine addicts.

Carlos works part-time as a mechanic in his brother's shop and part-time for the right-wing paramilitaries who control the barrio. "They call me and tell me to steal a Honda Civic or a motorbike," he says. Or they might call him up and order a murder, just like the old-time sicarios who served as Escobar's private army. I point out that he doesn't seem overly concerned about getting arrested. "The police have caught me with guns before," he says, but it turns out that his paramilitary boss is an ex-police officer who can clear things up with one phone call.

Medellín's culture of violence makes its streets



**ONCE A YEAR ISN'T ENOUGH:
DREAMING UP REASONS TO PARTY**



Streamers and passions fly at Mangos, a nightclub that celebrates New Year's Eve on the last Friday of every month. The appeal? The illusion of new beginnings in a city torn by uncertainty.



MARTA WAS SHOT IN THE LEG AS A

among the most dangerous on Earth: 2,193 people were murdered here in 2003, down from 3,774 in 2002. “Our violence has its origin in injustice and inequality,” Roberto Luis Jaramillo of Medellín’s National University says. “There isn’t only the [street] violence of the kids in the barrios—there’s also the [drug] millionaires who use killers-for-hire or paramilitaries.” And it’s guys like Carlos who do the dirty work.

In this Medellín has hardly changed at all since the days of Escobar, a typically industrious paisa who mythologized his humble upbringing to inspire the poor boys he pressed into his service. Escobar fancied himself as a barrio

Robin Hood; his self-proclaimed slogan for the city was “*Medellín sin tugurios*”—a city without *tugurios*, or shacks. One look at the city reveals Escobar’s lack of success, but his words still ring true to thousands of young guys on the make, whose families came to the city to escape the very violence that now consumes their sons.

Two years ago Carlos executed three young men because, he says, they were *sapos*, or frogs: They sang to the cops. “*El Patrón* [the boss] told us to make sure they were dead because he was very offended,” Carlos tells me, describing a scene that still makes him smile: rolling the bodies in blankets as police pounded on the door. Carlos



After a night of selling her body, Marta Correa awakens with one of her three daughters in a slum bereft of jobs. “My dream is to own my own business, anything that will allow us to eat,” says Marta, who earned brief fame as an actress in a film about street kids.

cédula, or identity card. Carlos shaved his beard and cut off the long curly locks that had earned him the nickname “Churros”—for the curly, deep-fried pastries sold on street corners.

I ask Carlos if he’d ever consider laying down his gun permanently.

Going straight, he replies, is only for those who can afford it. Sure, he’d like a new life, but he has three children to feed and he also supports his mother. In Medellín there’s a saying: “Son, get money in an honest way. But if you can’t, get it any way you can.” This is the machismo of the paisa way. So, too, is Carlos’s fondest dream: to buy his mother a house.

THE ACTRESS

The first time I met Marta Correa, 22, she sauntered across an alley in Barrio Triste and flung her arms around one of her best friends, filmmaker Victor Gaviria. Victor, who often uses non-actors in his films, cast Marta in a starring role in his 1998 internationally acclaimed film, *The Rose Seller*. Now he had come to interview her for a script he’s writing about the struggles of Medellín. Marta and her family, he told me, are the “heroes of everyday life.”

The Correa family lives in a *rancho*, or hillside shack, in one of the city’s toughest neighborhoods: the dizzying cliffs above the valley,

WARNING TO HER BROTHER ANDRÉS

fled through a window; his wife, Rosario, was not so lucky. She tried to tell the police that she’d just gotten home and didn’t know anything about the three dead men wrapped in blankets in her living room, but the cops didn’t buy it. She spent six months in prison. If they’d caught Carlos that day, even the paramilitaries couldn’t have fixed it. “I would’ve gotten 125 years,” he says.

After the murders, Carlos changed his identity, or rather the paramilitaries changed it for him. He says they paid between eight and ten million pesos (roughly \$3,500) to change his

where the roads are so steep that cars and buses have trouble climbing them. Marta tells people she lives in Popular, one of the poorest barrios in Medellín. But in fact, she lives higher up the hill—which means poorer—in Santo Domingo Sabio, which until recently was the city’s Marxist guerrilla enclave.

Marta’s brother Andrés was a *jefe*, a head of the guerrilla militia, until the paramilitaries seized the neighborhood in 2002. Funded by the millionaires and drug lords, the paramilitaries “bought” houses in the neighborhood, scaring people into selling for very low prices. Their goal



THE REAL STORY IS NOT HOW PEOPLE

was to bring Medellín's street gangs under their control and to rid the city of its last cells of left-wing guerrillas. Marta was shot in the leg to send a message to her brother, and Andrés was eventually hunted down. Cornered, Andrés switched sides and joined the paramilitaries. When the guerrillas learned of his betrayal, they threatened to kill his mother, Bernadita, in retaliation.

Bernadita tells me this as she waters an aloe vera plant hanging by the door for good luck. The family's dwelling is tidy, although its walls are pieces of scrap wood nailed together, with chinks of light streaming through. I notice that one of the planks used to be a board game.

Bernadita has lived like this since she moved to Medellín from the countryside in 1970. Now retired from her work as a housekeeper, Bernadita has gone a little crazy, Marta says. She sees Jesus floating over the sandlot soccer field across from her house, and constantly performs rituals for good luck. She spends hours tending the aloe plant or straightening icons of the Virgin Mary and Jesus, heart aflame, above the Barbie place mats and the Lucky Troll pinned to the wall. Her curious blend of superstition and faith is not uncommon in Medellín. But here even religion requires *high security*. On most street corners, brightly painted shrines to María Auxiliadora are



glassed-in or covered with bars; the Virgin's crown and scepter are frequently stolen.

Besides being an actress, Marta is also a prostitute. Two years ago, after her third daughter, Marjelly, was born, she headed to the streets—because of poverty, she says, “and the pain of seeing my kids and mother go hungry.” The money is good: She makes 40,000 pesos, or about 15 dollars, for 20 minutes' work. At first she hid her new job from Bernadita. Now it's no longer a secret, although Marta's children are too young to know what she does for a living. Nazli, the eldest, is getting curious. “One day I'll have to tell her what I do and that it's for her own good,” Marta says. “I'll hope that she doesn't reject me.”

In her cropped white satin jacket and perilous wedge heels, Marta resembles the character she played in *The Rose Seller*. Strangers recognize her on the street sometimes, and men stop and stare. “Hey, aren't you *that girl* . . . ?” they call out. Her face attracts clients, she says, although men are also a little afraid of her because she is—or was—famous. “I love doing things I've never done before; that's why I like being an actress. You can be another person,” she says. “That film changed my life. I just don't know how yet.”

THE DEBUTANTE

With her cell phone gripped tightly between ear and shoulder, Daniella Alzate Vélez slips out of her Diesel jeans and “Sweet Pea” T-shirt and into her first ball gown: a flouncy fuchsia number covered in flowers. This is her final fitting. The bodice is still too loose. Daniella's about to turn 15, and to celebrate, her parents are throwing a *quinceañera*—a “sweet-15” party with a DJ,

DIE HERE, BUT HOW THEY SURVIVE

Fashion models strike a pose (right) in the self-proclaimed Lingerie Capital of Latin America. Not far away, hillside shantytowns known as *comunas* (above) offer dubious haven for poor migrants fleeing the countryside, where violence still flares and drug-funded rebel forces can hold sway.





STARTING LIFE AT THE TOP IN A CITY OF HAVES AND HAVE-NOTS



Displaying the poise of a pro, a seven-year-old golfs with his brother at Campestre Country Club. Its \$10,000 family membership is one and a half times the nation's annual per capita income.



ASSASSINS HAD ARRIVED FROM BOGOTÁ

a discotheque, and a dinner for 114. She's also wearing a dress designed by Silvia Tcherassi, Colombia's leading designer. As she spins in the boutique watching herself in the mirror, she looks much older than 14, until her phone rings. She blushes and looks to the store's window, where the call is coming from. Her boyfriend of the moment and her best friend, Juliana, are out there, trying to sneak a look at the birthday girl. Daniella hides from them beneath the counter, lost in yard after yard of pink tulle.

When the Saturday of the party finally arrives, Daniella spends the afternoon at Tantra, her mother's favorite beauty salon. A pop song,

"Barbie Girl," plays in the background. Daniella's mother, Natalia Vélez Díez, 36, has just gone back to work after years as a housewife. Last year Natalia went to Italy to learn how to operate some Italian machines she had just bought that claim to break down cellulite *and* reduce wrinkles. Natalia was stopped by Italian immigration simply because her passport read "Colombian." Everyone assumes all Colombians are drug dealers, she tells me. "Not true, not true."

Natalia was never a quinceañera herself; her parents couldn't afford it. That's why, she says, Daniella's party is really hers too. She looks at her watch and gasps: It's already eight o'clock. The



party starts in an hour at Celebrations, a fancy club, and neither she nor her daughter is dressed.

"I've got butterflies!" Daniella says, pressing her hands against her stomach and stepping into the small world of her dress. She is especially nervous about tonight's waltz, the pivotal moment of the evening.

Later, when that moment arrives, Daniella crosses the bridge built over the swimming pool lit with tiki torches. Everyone claps as she sweeps into the ballroom and waltzes with her stepfather, Jairo Alzate, who's in the resort business. Daniella's biological father was killed in Bogotá almost 15 years ago, the day he was planning to fly to see Natalia on her birthday and his newborn baby, Daniella. He never arrived.

It's after midnight, and the disco bass pulses. The partygoers glisten with sweat. Some pair up and head quietly outside. Bob Sadowsky, the party planner, says he has a plan to curtail his underage guests' romantic forays into the bushes: He has installed trip wires. In case things get hot and heavy, he says, the entire perimeter floods with light. Bob also keeps a big bowl of lollipops by the door, so that when the rowdy partygoers leave, they don't chatter in the parking lot and disturb the neighbors.

Daniella's quinceañera ends up raging until noon the next day. In Medellín, for young people of means, party culture rules. Down the road at a nightclub called Mangos, New Year's Eve is celebrated every month, as if January might not roll around next time. In Medellín, any chance at starting again—no matter how concocted—is an excuse for a party. You don't ask questions. You kick up your stilettos and dance.

TO KILL A "TOUGH LITTLE LADY COP"

Shrouded by a makeshift mask, a leftist rebel in his prison cell (above) displays an image of revolutionary Che Guevara. Police investigator María T. (right)—target of many death threats—walks to a murder scene flanked by bodyguards. Her face is obscured for protection.



The squalor of Barrio Moravia (right) led the late drug lord Pablo Escobar to build new housing for the poor. Revered as a hero by some, Escobar is reviled by many others for his legacy, which the city still fights to shed.

THE CANDY SELLER

More than 100,000 children work the streets of Medellín, but Miguel is the one I know best. He stands about four feet tall with a bristle cut and the smile of a natural-born salesman. Selling candy on the city bus, Miguel helps support a household in which everyone contributes. But he's also a ten-year-old kid who likes candy, and that's where self-discipline comes in. Every day, he says, he allows himself to eat one—and only one—piece of his wares. “If I ate more than one, I'd eat them all,” he says.

Miguel lives with his grandmother, who works in a factory shucking corn, and his grandfather, a watchman, along with four young uncles and his two brothers in a two-room apartment in a northern barrio. Like so many of Medellín's working poor, Miguel's family left the coffee-growing countryside to escape the violence there. When he was a toddler, his mother abandoned Miguel and his brothers. “She threw me away, so my grandparents came and picked me up,” he says. Once he saw her in a photograph. She had long red hair and her skin looked pale, but that's all he remembers.

Each morning his grandmother gives Miguel 2,000 pesos (about 75 cents). After school he goes to the candy store to buy a bag of coffee caramels. Then he gets on the bus and announces to his captive audience of shopkeepers and factory



THIS IS MEDELLÍN, AFTER ALL, WHERE

workers: “Excuse me, ladies and gentlemen, I'm sorry to take your precious time, but I am selling candy.” It works. He makes about 4,000 pesos a day and delivers the money to his grandmother.

When Miguel and I last spoke, it was several weeks before Christmas. I met him downtown after school and tagged along as he bought candy and worked the bus up the valley until we reached his neighborhood, called Zamora. His grandmother came in from the corn factory, and we sat on the two beds of their apartment to talk. Weeks earlier Miguel had told me he wanted a bicycle for Christmas, but that was clearly out

of the question. In fact, his grandmother said, they would ignore Christmas entirely. Miguel and his brothers would have the day off from school, of course, so she planned to take them to the factory to shuck corn, where they could pretend it was just another Sunday at work.

My last day in Medellín was the second of December, ten years to the day after Pablo Escobar's death. To mark the occasion, Escobar's grave at Jardines Montesacro had been tented and covered in white flowers. As I approached, the sky opened, and big oily raindrops splatted down on the grave's white tent.



EVEN THE DREAMERS ARE TOUGH

I was there when a heavysset man in black-and-white checked pants arrived, huffing on a bicycle, to pay his respects. He worked for Escobar, he said, and called himself Darío the Chef. I sat for a while on a wet bench and listened to his tales of life with Pablo, who loved nothing better than a big plate of scrambled eggs. To Darío, Escobar was “a humble man committed to justice,” who once built an entire neighborhood for displaced people who’d been living on a trash dump.

People in Barrio Pablo Escobar, as the neighborhood is known, still remember how, one night, they raced to claim half-built houses he’d given them. For them Pablo is a hero. He is for others

too, like Andrés and Carlos, so desperate to survive that they cling to a dead man’s dream, built of money and drugs and death.

Others here, like Marta and María and Miguel, are looking for another story to believe in. And no one I spoke to—not one person—is ready to give up on hoping for it, even when life has other ideas. This is Medellín, after all, where even the dreamers are tough. □

TOUR THE FANTASY WORLD of the late drug lord Pablo Escobar via video of his “toy” collection—vintage cars, a bullring, and live hippos. Then view a photo gallery with tips from Meredith Davenport at nationalgeographic.com/magazine/0503.

attack of the

All over the world, animals and plants that evolved somewhere else





alien

are turning up where they're not wanted

invaders

slither

Why do Burmese pythons cross Florida roads? Because the onetime pets get too big and hungry for owners to handle. Native Everglades wildlife is threatened as pythons multiply—an ecological cancer mirrored worldwide by a host of invasive species.

PYTHON MOLURUS BIVITTATUS
(CAPTIVE SPECIMEN)

smother

Jason Millsaps rips into a shroud of kudzu covering a car in his Georgia yard. The “vine that ate the South,” imported from Japan in the late 1800s for erosion control and animal feed, has spread over 1.5 million acres in the U.S. “I’ve measured a foot a day,” says Daisy Millsaps, Jason’s mother. “It’s a never ending battle to keep it back.”

PUERARIA MONTANA





BY SUSAN McGRATH
PHOTOGRAPHS BY MELISSA FARLOW

In the hour of long shadows

and cooling tarmac, the snakes of the Everglades slip out in search of supper. Cruise control set at 25, my cherry red sports car slips out after them, prowling ceaselessly back and forth, back and forth, on the two-lane river of tar that runs through the park.

At 8:23 a short, fat snake appears, immobile, in my lane. I leap out to examine the stubby little creature and—*Tssssss!*—it flicks its head straight back and snaps its jaws open, presenting a sinister flower of petal pink flesh. Yikes. A cottonmouth. I hop back in the car. At 8:28 a dark, sinuous snake, slim as a bootlace—too slim to be what I'm looking for. At 9:03 another little fatty, worth a closer look. Nope. A pygmy rattlesnake, maybe.

Then a dry spell. At 10:00, headlights appear behind me. I watch them coming on fast in the rearview mirror and when my gaze returns to the road ahead, there's my snake—a road-block of a snake, as thick as a thigh and as long as the lane is wide—and I'm almost on top of it. I mash the brake pedal and fling out an arm to warn the driver behind me. The vehicle swerves around me. An instant before contact, the driver sees the snake, lurches onto the shoulder, lurches back onto the road, and speeds away. The glossy argyle of bronze and charcoal lies unscathed.

Python molurus bivittatus, the Burmese python, is a species you won't find in any field guide of the endemic reptiles of North America; it's a native of Southeast Asia. But anyone in Florida who wants to see one in the wild can try the Everglades National Park road on a summer's eve. It's a bizarre sight: The guy in my headlights is already bigger than any other snake in North America, yet it's a mere pipsqueak by its own

standards. It may live 25 years and reach 20 feet in length. It can achieve the girth of a telephone pole; it can dine on full-grown deer.

Skip Snow, a park biologist, has examined scores of Burmese pythons found in the Everglades in the past few years, hatchling, juvenile, and adult. "There's little doubt they've become established and are breeding here," he told me, though you could see he still has trouble believing it himself.

If Snow were here tonight, he'd pin this ten-footer with a snake stick, wrestle it into a rubber tub, and run it back to the lab where he'd euthanize and autopsy it. But Snow is busy elsewhere, and yours truly is cowering in the sports car, fighting an absurd urge to lock the doors. The animal lies still just long enough for me to get a good look, then glides heavily into the scrub.

Back at Flamingo Lodge, I blurt my news to the night manager.

"So you saw a ten-foot python," he drawls. "That's nothing."

Some call it the "blender effect," others "a giant biology experiment with no one in charge." What it boils down to is this: All over the world, in nearly every region and kind of ecosystem, animals and plants that evolved somewhere else are turning up where they're not wanted—having been transported by us, inadvertently or intentionally. Burmese pythons are imported to



EUBLEPHARIS MACULARIUS

Charlie Vogel, 8, pleads with his father for a leopard gecko at a reptile-breeders show in Florida. This lizard is not considered an environmental threat, unlike many snakes and lizards for sale here. Some two million exotic reptiles are imported to the U.S. each year.

Florida from Asia for the pet trade and end up being dumped in the Everglades by people who find that they don't make such great pets after all. Pythons are generalists—long-lived, not too fussy about what they eat—so they survive, find one another, and breed.

Likewise, Western species pop up in the East. The red-eared slider turtle, native to the Mississippi Basin, has been shipped all over the world as a pet and for food. The turtle is spreading across Asia and southern Europe, devouring native frogs, mollusks, and even birds.

Some alien species are beneficial. Most agricultural plants and animals in North America are aliens, for instance—native to Europe, South America, or elsewhere. Japanese oysters and clams are mainstays of the shellfish industry worldwide. But some transplants have an outsize effect on the ecosystems into which we deliver them. Ecologists call these “invasive species.”

It's too soon to know how invasive the Burmese python will prove, but consider the case of the brown tree snake, a native of New Guinea and Australia. A few of them stowed away aboard military equipment after World War II and disembarked on the island of Guam. There they found no brown tree snake enemies and no brown tree snake rivals and tens of thousands of birds that had never known a terrestrial predator. In this land of milk and honey the snakes have multiplied exponentially, reaching densities of up to 13,000 a square mile. Their venomous bites account for a disquieting number of emergency room visits; their climbing habits have caused more than 2,000 electrical outages; and 8 of Guam's 11 native forest bird species have been wiped out.

North America got its wake-up call with the arrival of the zebra mussel, a thumbnail-size mollusk native to the Black Sea that showed up in Lake St. Clair, Ontario, in 1988. Zebra mussels like to attach themselves to a hard surface, and they don't mind a crowd. They'll clump on rock, they'll clump in pipe, and they'll clump mussel-next-to-mussel-atop-mussel in astonishing congregations of as many as 70,000 individuals a square foot. Within two years

zebra mussels tiled the shallows of the Great Lakes. Intake pipes from utilities and factories became choked with mussels. Lights dimmed. Ships' rudders jammed. Businesses closed. Eradication proved impossible, and today the U.S. and Canada lose about 140 million dollars a year to the mussels.

Aggressive plants may be the most destructive of all invasive species. Mile-a-minute weed, *Mikania micrantha*, a perennial vine from Central and South America, was planted in India to camouflage airfields during World War II. Today it camouflages large swaths of southern Asia, overrunning forests and crops and smothering life under a green blanket.

"Before humans started moving around, the rate of species movement was a geologic rate," says Jim Carlton, an invasives expert who is the director of the Maritime Studies Program of Williams College and Mystic Seaport in Mystic, Connecticut. "Now we're moving species faster

and farther than they ever would or could have moved in nature."

That movement comes with a shocking price tag. The state of Florida spends 50 million dollars every year controlling invasive plants. New York, New Jersey, Illinois, and the federal government have spent 175 million dollars battling the tree-killing Asian long-horned beetle. The 2001 hoof-and-mouth disease outbreak in England cost businesses there nearly four billion dollars. In all, experts estimate, invasives cost the U.S. alone more than 140 billion dollars yearly.

The less quantifiable effects are no less terrible. The ecologist E. O. Wilson ranks invasive species second only to habitat destruction in the magnitude of the threat they pose. In removing natural barriers to species movements, Wilson says, we're changing the very nature of wild places, replacing unique animal and plant communities with a generic, impoverished hodgepodge world of hardy generalists: a world not



of Sumatran rhinos, golden turtles, Blackburnian warblers, and giant saguaro but merely one of cats, rats, crows, and West Nile virus.

Picture a starlit Maui evening. Balmy air, green-gold pools of light among the bromeliads and ferns. An invisible frog chorus provides live music—*co-KEE!* Human soloists contribute a reedy counterpoint—*GOT-one!*

Mele Fong shines her light at the base of a leaf to reveal a plump, orangey brown frog no bigger than a bottle cap. He inflates his throat and shrieks *co-KEE* at 90 decibels—as loud as a lawn mower. She grabs the little guy, and into the freezer-bound Ziploc bag he goes.

Fong, then the Maui Invasive Species Committee outreach specialist, and Fern Duvall, a state wildlife biologist, are showing a neighborhood group how to find a Caribbean tree frog called, not surprisingly, a coqui. By removing the frogs in mildly infested areas, people can help keep them from spreading—and keep their own gardens frog free. It's too late for that here: This garden backs onto a highly infested wooded ravine. Duvall estimates that there may be 10,000 little frogs within earshot tonight. Breeding males start calling in the evening and can call all night—all year long.

Few things have gotten the Hawaiian public's attention like this "quarter-size frog with the

Invasives take a staggering toll on the world's economy. They cost the U.S. alone 140 billion dollars a year.



In the Old West, cattlemen battled sheepherders over grazing land. Today there's a new enemy—a Eurasian weed called leafy spurge (lower right) that overwhelms native grasses. In North Dakota, the hardest hit state, spurge covers 1.2 million acres once graced by prairie smoke and other native plants (upper right). Cows hate spurge, but sheep love it, so ranchers have put the old rivalry to rest for good. On Joe and Shannon Fritz's ranch, where two cowboy sprouts practice roping (left), 240 sheep mow down spurge, leaving grass to the cows. The Fritzes use another biocontrol tactic: a beetle that eats only spurge.



GEUM TRIFLORUM (TOP); EUPHORBIA ESULA

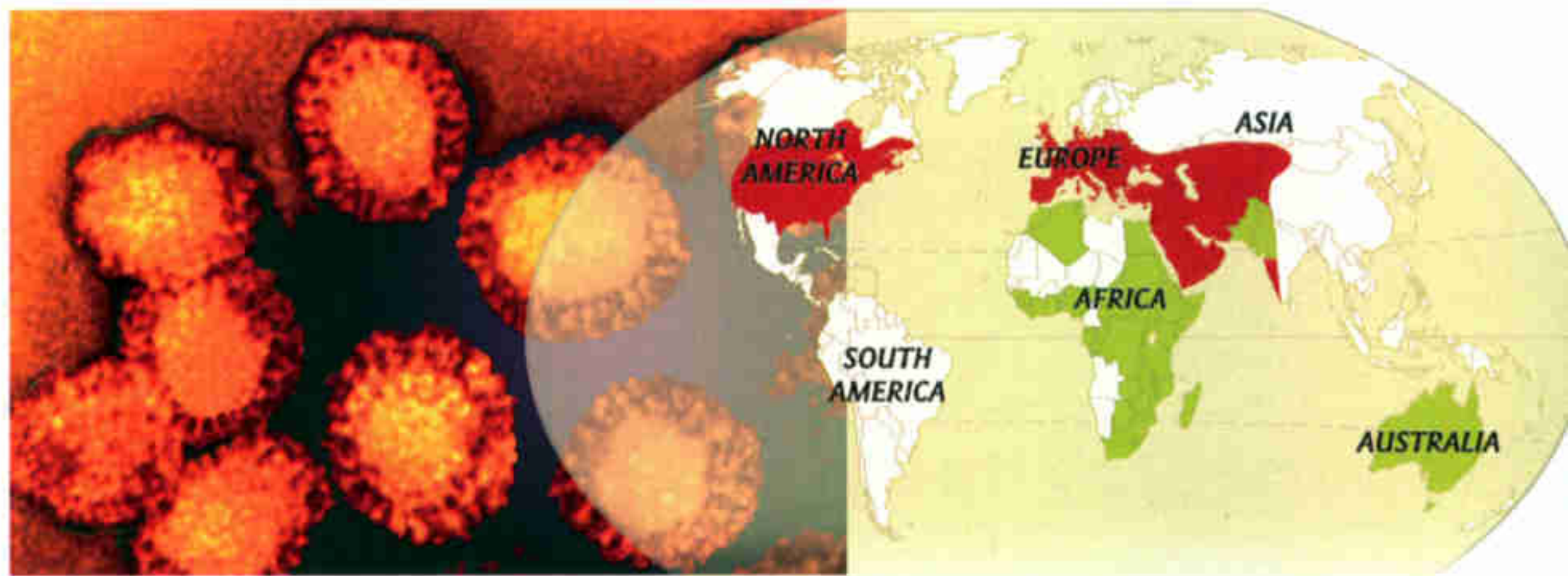
global swarming

 Native range

 Invasive range

West Nile virus

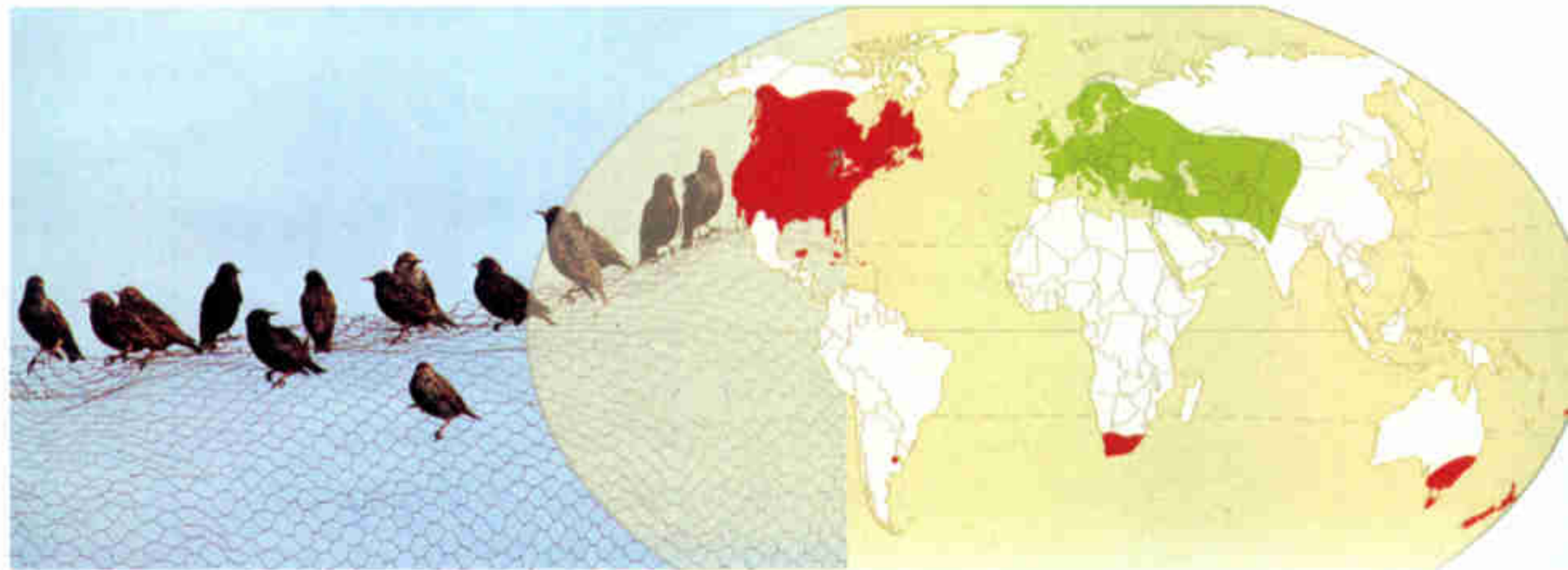
Carried by infected birds and spread to humans by mosquitoes, this virus, first identified in Uganda in 1937, has emerged in many countries in recent years. A strain native to Australia may also have spread. Usually not fatal to healthy people, it has nevertheless sickened thousands and killed hundreds worldwide.



FLAVIVIRUS; LINDA STANNARD, UCT/SCIENCE PHOTO LIBRARY • MAP SOURCE: CURTIS G. HAYES, NAVAL MEDICAL RESEARCH CENTER

Starling

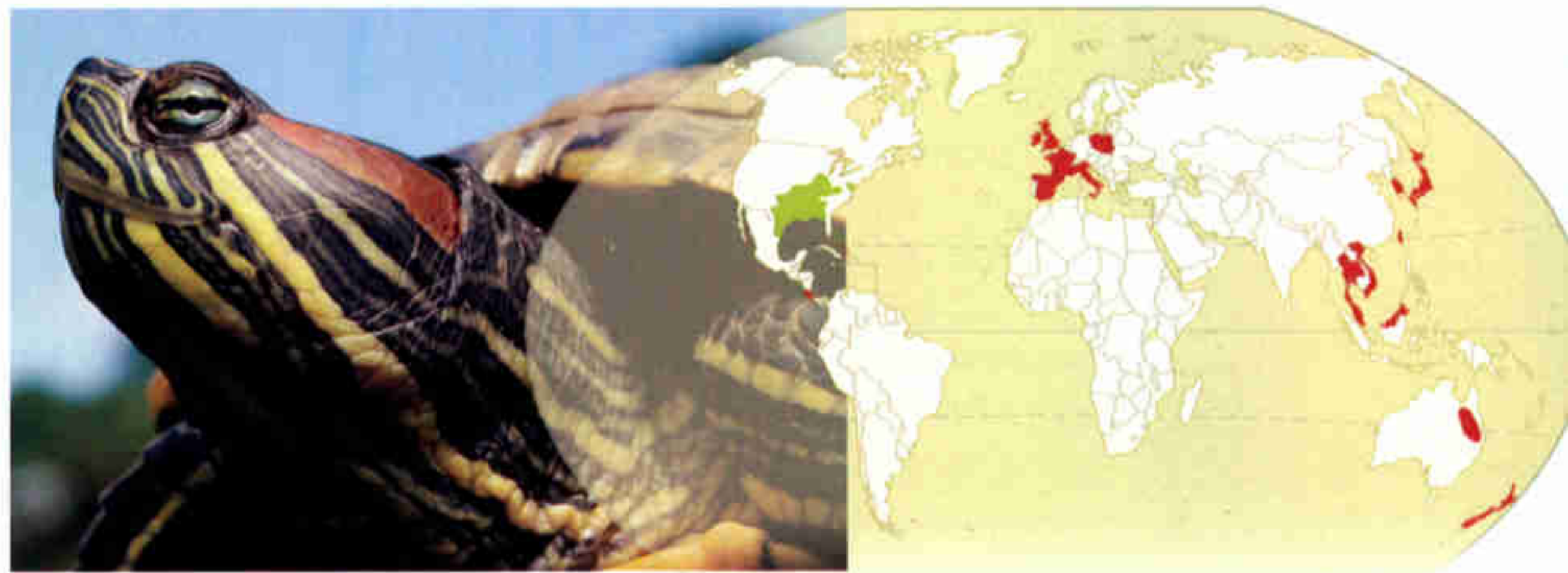
A native of Eurasia and North Africa, the European starling has spread around the globe. It crowds out native bird species by taking over their nests and by consuming insects the native birds need to survive. Farmers resent the starling because it can also foul cattle feed and lay waste to crops.



STURNUS VULGARIS; RICHARD VAUGHAN, ARDEA • MAP SOURCE: CHRIS FEARE, WILDWINGS BIRD MANAGEMENT, U.K.

Red-eared slider

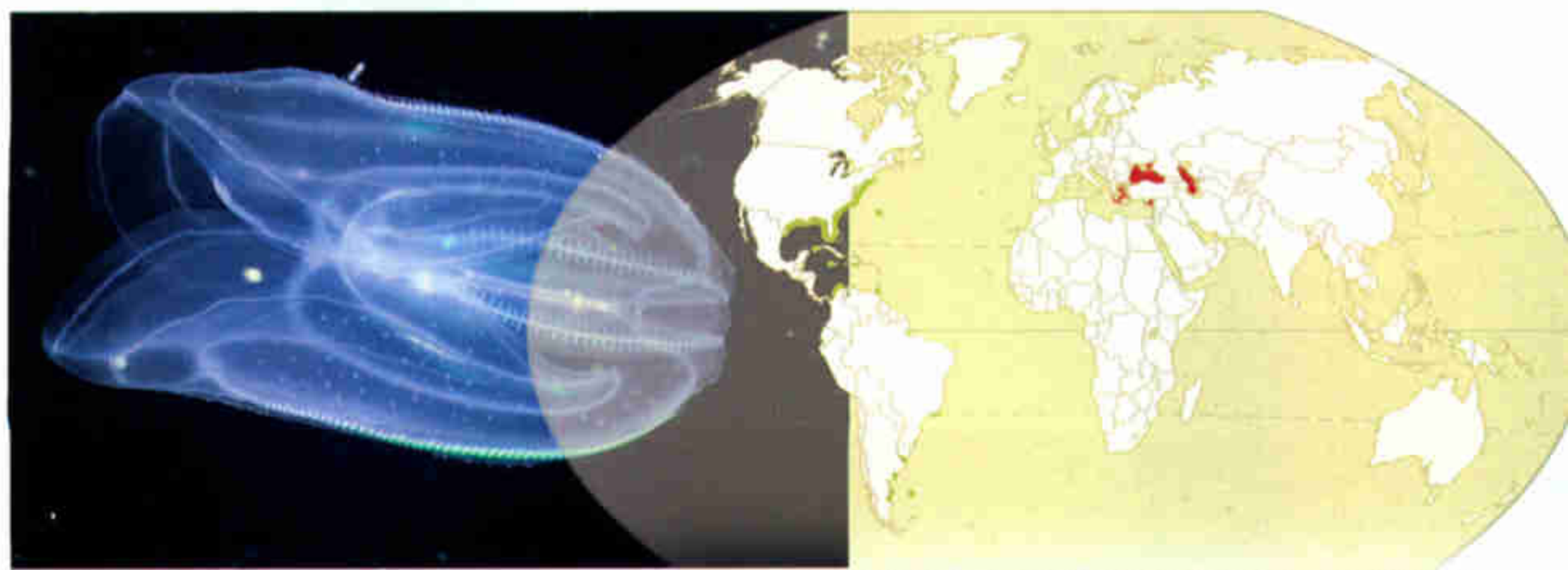
This North American turtle has spread to distant habitats because of its popularity as a pet and a source of food. It lives in marshes and waterways, where it competes for the same prey, insects and insect larvae, native turtles eat. The red-eared slider also eats native frogs, mollusks, and birds.



TRACHEMYS SCRIPTA ELEGANS; WILLIAM PATON, NHPA • MAP SOURCE: PAUL PENDLEBURY

Comb jelly

Comb jellyfish were sucked out of the water along the Atlantic coast of the Americas and carried in the ballast tanks of ships to the Black Sea. There they consume plankton and fish eggs, throwing the marine ecosystem out of balance. In 1999 the comb jelly spread to the Caspian Sea.



MNEMIOPSIS LEIDY; HERB SEGARS • MAP SOURCE: TAMARA A. SHIGNOVA, P. P. SHIRSHOV INSTITUTE OF OCEANOLOGY, RUSSIAN ACADEMY OF SCIENCES

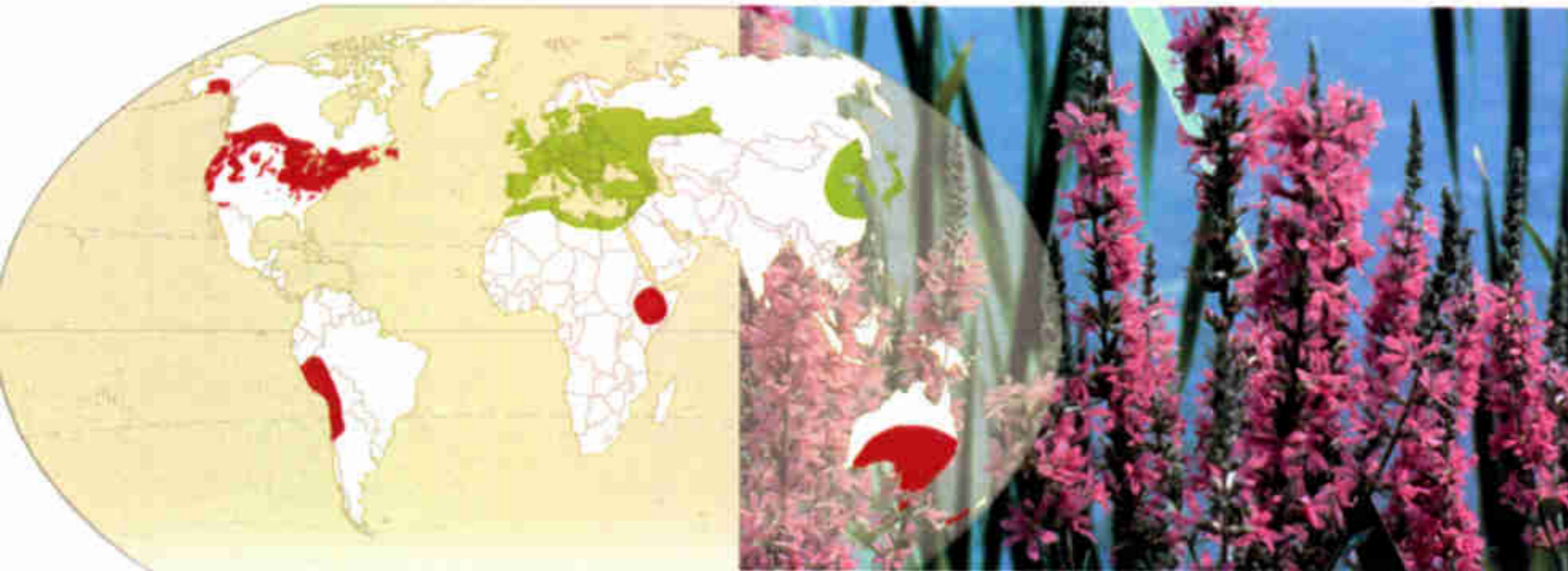
Organisms labeled “invasive” range from the scary—West Nile virus—to the fuzzy. People have brought many exotic species into new environments for use as food, decoration, or pets. Other species have hitched rides with cargo shipments. Some are benign. But many, like the sampling below, make themselves too much at home, wreaking ecological havoc.



Nutria

A large South American rodent, the nutria has been imported into many countries by entrepreneurs hoping to sell the fur. When the animals escape, they cause erosion by overgrazing riverbanks and dikes. Their voracious feeding and burrowing habits threaten native habitats.

MAP SOURCE: JACOBY CARTER, NATIONAL WETLANDS RESEARCH CENTER, U.S. GEOLOGICAL SURVEY • MYOCASTOR COYPUS; ACHIM WINKLER



Purple loosestrife

This Eurasian plant has been used in gardens as an ornamental, aiding its invasion of North America, Australia, and part of Africa. It spreads quickly: eliminating open water, establishing thick stands, and choking out native plants that are important food sources for birds and wildlife.

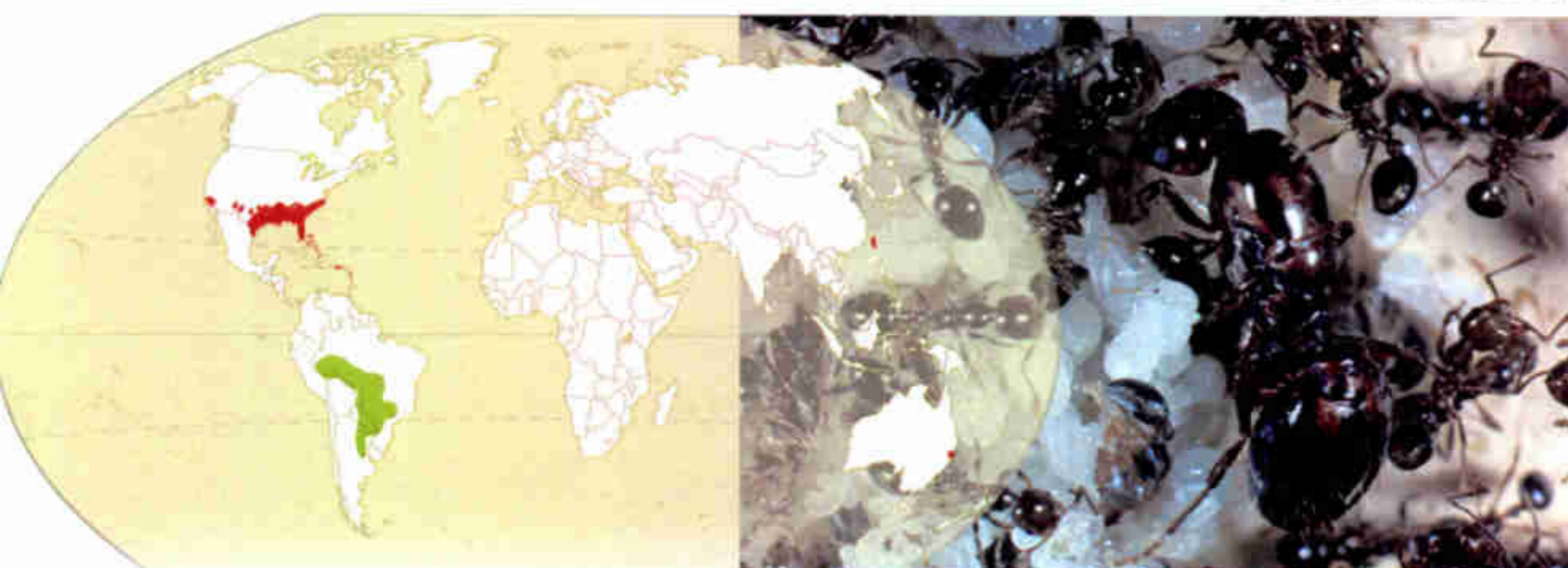
MAP SOURCE: BERND BLOSSEY, CORNELL UNIVERSITY • LYTHRUM SALICARIA; FRANK BRAMLEY, NEW ENGLAND WILD FLOWER SOCIETY



Red fox

Hunters in search of new quarry spread this familiar carnivore species to Australia and Vancouver Island, British Columbia, as well as to parts of the U.S., where it mixed with native foxes. Red foxes thin out bird and mammal populations and have contributed to extinctions in Australia.

VULPES VULPES; JOEL SARTORE



Fire ant

Red fire ants, a South American species introduced to the United States accidentally in the 20th century, inflict venomous stings that can harm humans and pets. They can also drive out other ant species, reptiles, and mammals, and inflict significant damage to crops.

MAP SOURCE: S. D. PORTER, AGRICULTURAL RESEARCH SERVICE, U.S. DEPARTMENT OF AGRICULTURE • SOLENOPSIS INVICTA; S. D. PORTER, USDA-ARS

Brown tree snake

Accidentally taken to Guam after World War II, this arboreal serpent, which can grow to nine feet, destroyed much of the island's native fauna and disturbed its ecology. Birds and fruit bats—key pollinators and spreaders of seed—were decimated. Officials on other Pacific islands now take precautions against its import.



BOIGA IRREGULARIS

million-dollar voice,” as *Hawaii Business* magazine dubbed it. Entering the Pacific on nursery plants from Puerto Rico, the newcomer occupies pockets of Hawaii in numbers so biblical that the Big Island has declared a state of emergency to qualify for federal funds to eradicate it.

Having a thousand car alarms shrilling in your garden all night, every night, is understandably unfortunate, and failure to disclose that coqui frogs are on your property when you sell it can get you sued in Hawaii. But these are the least of Hawaii's coqui worries. A deafening, all-night chorus could hurt tourism, pillar of the economy. It's already dampened the 80-million-dollar nursery export business. And Fern Duvall points out that the frogs will eat a billion insects, robbing native birds of food.

Fong and Duvall are dismayed by the strength of tonight's chorus, but “there's an educational opportunity here,” Fong says. Maybe the spotlight on the frogs will illuminate the broader problem of invasives, helping Fong and others make headway against the species that have them lying awake at night. Miconia, for instance.

“In the Kurt Vonnegut book *Cat's Cradle*, there's this material called Ice-9 that binds water permanently and destroys the world,” Art Medeiros, a U.S. Geological Survey botanist, says. “Miconia is like Ice-9.”

A tree with leaves the size of a small child, *Miconia calvescens* evolved in heavily canopied forests in South America. There it hangs back until a tree falls and creates a light gap, which it races to fill. Pacific Island forests, in contrast, have airy, discontinuous canopies. Without canopy-forest competitors, miconia fills all the light gaps, creating canopies as continuous as awnings, under which few animals or other plants can live.

“It's like a biological desert under there; completely silent,” Medeiros says. Miconia has already invaded the island of Tahiti and replaced two-thirds of its native forest. The government there has given up trying to control miconia, but that's not the end of the story. Even if they accept the eradication of their native fauna and flora, the Tahitians still need soil and watershed protection. Miconia is extremely shallow rooted. When all the trees are miconia, there's little to anchor the forest and soil on slopes. Landslides are stripping the island of both.

This “green cancer” also infests tens of thousands of acres on Maui, where the soil is loaded with miconia seeds. Maui County deploys a 13-person team intent on destroying plants before they can set more seed. It's not enough.

“Right now, there's a window of opportunity with miconia and other weeds—a chance we can keep them under control. But at the rate we're working,” Medeiros says, “things don't look good for Hawaii's plants and animals.”

Miconia reached Tahiti and Hawaii as an ornamental tree, a precursor to the multibillion-dollar global business in exotic pet, aquarium, and nursery plant species that is responsible for an extraordinary shuffling of wildlife around the planet. Much of that trade passes through Miami, a scant 75 miles from where Skip Snow chases pythons. Tom Jackson, a NOAA biologist, gave me a tour. First stop, Snakes at Sunset. Here, two kids have their noses glued to a tank in which three black-and-yellow Nile monitor lizards scamper about.

“They'll be seven feet long before you know it, and they have nasty temperaments,” Jackson says. “Kids, don't buy these.” He looks sternly at their mother.

Mother probably doesn't know it, but not far away an ecologist named Todd Campbell is trying to eradicate a large population of these carnivorous lizards in the bedroom community of Cape Coral. Campbell's not as worried about the bedrooms as he is about two national wildlife refuges within swimming distance of town.

(Two wildlife species you won't find for sale in pet stores these days are Gambian rats and prairie dogs, thanks to a nightmarish scenario that played out in 2003. Prairie dogs at Phil's Pocket Pets, in Villa Park, Illinois, had been previously housed next to Gambian rats shipped



AXIS AXIS

Over 40 percent of all imperiled U.S. native plants and animals are at risk because of invasive species.

Brought from Asia as a royal gift to the Hawaiian king over a century ago, axis deer today are simply a royal pain. Thousands inhabit the islands, stripping vegetation, speeding erosion, and causing car wrecks. One benefit: They attract hunters like these (above) savoring success on Lanai. Another pest, the coqui frog (right), arrived accidentally on imported Caribbean plants. The frogs' loud, incessant mating calls drive Hawaiians wild—though not with love.



ELEUTHERODACTYLUS COQUI





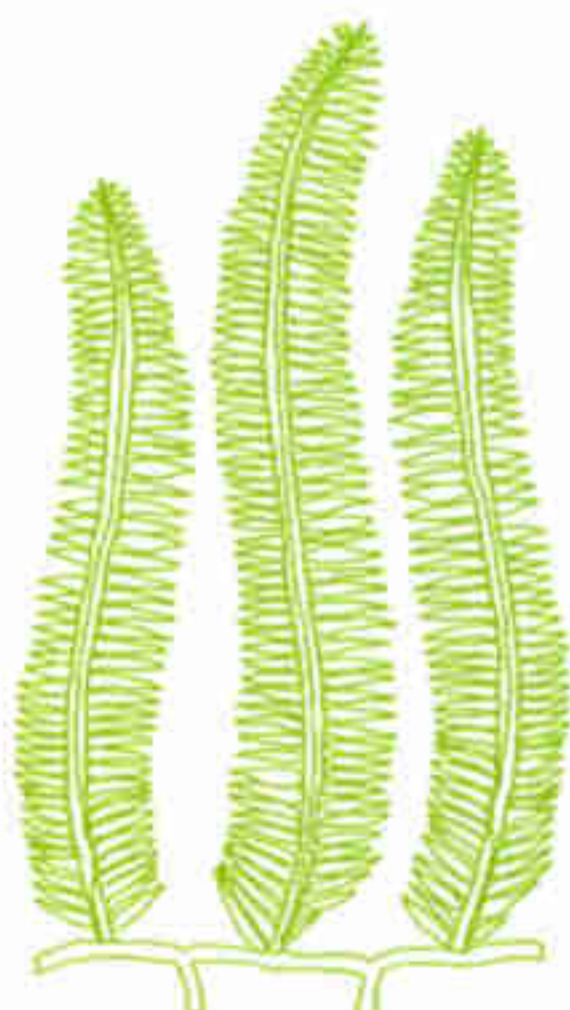
devour

Four generations of the Kanoa family are on hand to harvest taro on Maui, where farmers have grown the Hawaiian staple for hundreds of years. But the golden apple snail, introduced 15 years ago, threatens the crop. Imported to be raised and sold for food, the snails never found a market but did take a liking to taro.

"They'll eat all the taro in a patch before it can mature," says Gladys Kanoa, at far right.

***Caulerpa* seaweed**

A native of tropical seas, *Caulerpa* was found in two spots off southern California in 2000. Fearful it would choke out native plants, as it has elsewhere, scientists attacked with chlorine and close monitoring and are now hopeful: No new populations have been spotted since 2002.



CAULERPA TAXIFOLIA

from Africa. The rats were infected with a dangerous smallpox relative called monkeypox, which skipped to the prairie dogs and thence to their new owners. Fortunately no one died, but more than 70 people in six states were sickened before the Centers for Disease Control and Prevention traced the source.)

Next stop on Jackson's tour of Miami is Exotic Aquariums, boasting aisles of glittering exotic fishes, many of which—including the poison-spined lionfish—you can now find in U.S. waters.

More damaging than any fish, says Jackson, is the aquarium strain of a tropical seaweed, *Caulerpa taxifolia*. In 1984 a sprig of *Caulerpa* was dumped into the sea from Monaco's oceanographic museum. When it was discovered, three years later, the *Caulerpa* colony wasn't much bigger than a bath mat. But "France and Monaco argued about how it got there," says Dan Simberloff, director of the University of Tennessee's Institute for Biological Invasions. "Then they argued over which agency was responsible for it. Then they argued over whether it would become problematic. When they finally got around to dealing with it, it was too late. Today, *Caulerpa* carpets 30,000 acres of the Mediterranean. If they'd just jumped in when they found it and pulled every scrap, they could have nailed it."

Despite the calamity in the Mediterranean, the U.S. didn't prohibit the sale of *Caulerpa* until 1999. The next year, *Caulerpa* was found growing in the water northwest of San Diego. Authorities acted with impressive speed, isolating and poisoning the *Caulerpa* patches in a four-million-dollar strike that appears to have been successful.

Tour over for the day, Jackson drives me back to his bungalow to pick up my car. On

his doorstep we find a plastic tub with a frog inside and a note on the lid: "Tom, I found this in my pool. Any idea what species?" Jackson can't say offhand. The amphibian's not from Florida, but it could be from almost anywhere else in the world.

Restricting the entry into the United States of alien species such as *Caulerpa* and zebra mussels, already known to be invasive elsewhere, would be almost automatic, one would think. The reality is more complex—and far more difficult. In most countries, unless a species is on a short blacklist of noxious weeds or injurious wildlife, or restricted under the Convention on International Trade in Endangered Species, you're free to import it. (Australia and New Zealand have abandoned this presumption of innocence in favor of a more effective "clean list" of approved species; species not on the list are denied entry.)

A lone fisherman dips his line into a San Francisco Bay that has lost many populations of its native aquatic species in the past 150 years. One potential culprit motors past in the background. Each ship in this busy port carries, on average, a million gallons of water in ballast tanks, for stability in open waters. (Large ships often carry 20 million gallons.) In the past, water taken up in a distant port—and whatever was in it—was released here, devastating the ecosystem. California attempts to regulate the practice, but it is still common here and in ports the world over.



Further hampering prevention efforts in the U.S. is a lack of coordination between government agencies, and the fact that agencies have multiple, sometimes conflicting mandates. The U.S. Department of Agriculture keeps the noxious-weed list, but focuses primarily on protecting agriculture and the nursery trade, not wilderness. Thus it took the USDA five years to list melaleuca, the highly invasive Australian paperbark tree that had converted 500,000 acres of native Florida wetlands to forest.

The U.S. Fish and Wildlife Service regulates the trade in wild animals, but it's also charged with promoting industries like aquaculture that are often responsible for introducing invasives. When three species of Asian carp escaped from catfish farms into the Mississippi River, Illinois petitioned the wildlife service to add Asian carp to the injurious wildlife list; aquaculturists lobbied against the listing. Three years later a decision is still pending. In the meantime, the

U.S. and state governments are resorting to a nine-million-dollar electric barrier to keep Asian carp out of the Great Lakes. State departments of fish and game, for their part, are charged with protecting the environment from invasives, but they often manage alien game species such as feral pigs and exotic deer for hunters.

Some experts believe the answer is a well-funded national center for invasive species based on the Centers for Disease Control and Prevention model. Though Congress took a first step in 1999, establishing the National Invasive Species Council, it has remained underfunded.

"As a society we've adopted an exclusively reactive mode," says David Lodge, an ecologist at the University of Notre Dame. "Invasives aren't like other forms of pollution. They don't stop spreading when you stop releasing them. They grow, and they grow in an accelerating manner. Doing nothing to prevent them is a particularly damaging policy."



multiply

Kitty cats an invasive species? You bet. Tens of millions live wild in the U.S., killing hundreds of millions of songbirds, reptiles, and mammals. Irresponsible pet owners are to blame, but it's the cats that often pay the ultimate price if caught. Not these lucky kittens, however. A volunteer organization in the Florida Keys will neuter them and, if they're not adopted, release them, unable to produce a new generation of predators—but still able to silence songbirds.

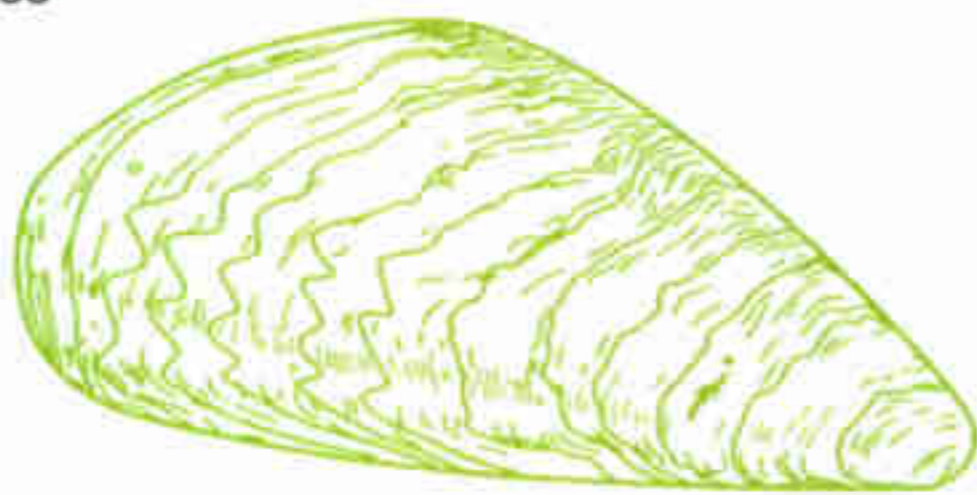
FELIS CATUS





Zebra mussel

Transported to North America in ship ballast water, this Eurasian bivalve is crowding out native clams and mussels. It has also caused economic havoc in the Great Lakes and major river systems, where it reaches densities high enough to clog water intake pipes.



DREISSENA POLYMORPHA

At Pier 39 in San Francisco Bay, a Mad Hatter's tea party of marine biologists has made itself at home on a dock. Several huddle around an orange washtub using tweezers to sort through a malodorous slurry; others scrutinize bewildering aggregations of glop and argue Latin nomenclature; one scowls at a fastidiously coiled rope. For their purposes, "the more derelict the dock the better," says Andy Cohen. Anything left dangling overboard accumulates the shaggy coat of marine organisms known as fouling.

Cohen, a marine biologist at the San Francisco Estuary Institute, organized this weeklong outing—a rapid-assessment survey in which biologists collect organisms at 15 sites around the bay to see what's shown up since last time they looked.

"You never know what you're going to find," Cohen says. "It's like a story unfolding before your eyes."

The San Francisco Bay and San Joaquin Delta constitute the biggest estuary system on the west coast of the Americas. One of the world's busiest international ports, it harbors a million wintering shorebirds, supplies drinking water to two-thirds of Californians, and nurses the young of many marine creatures. Cohen believes it also qualifies as the most invaded aquatic ecosystem in the world. In some parts of the bay, 90 percent of species are alien.

At the disappointingly shipshape Coast Guard dock, four or five seamen wince as Jim Carlton of Williams College claws up a handful of silty invertebrates fouling the bottom of a float.

"Where do the exotic ones come from?" a seaman asks.

"This sea squirt is from New England. This little mussel is from Japan," says Carlton, sorting through his haul with a mucky finger.

"Do you have anything from here?"

Carlton smiles ruefully. "Not in this pile, no."

They stare for a moment. Then, "How do they get here?"

"Oh, fouling is responsible for quite a few," Carlton says, "especially from the gold rush, when so many old, heavily fouled wooden ships sailed in and were abandoned here. The oyster trade. Fish bait. Ballast water brought the rest."

Big cargo ships often carry 20 million gallons of ballast water. They pump it into and out of one or more tanks to keep the ship stable. They take on ballast water in one harbor, dump it out in another; take on water in Boston, dump it out in Odessa. The ships draw in not only water, but whatever's in it. Sampling has turned up as many as 300 species on a single ship, from schools of 12-inch fish to the microscopic dinoflagellates that cause red tides.

More than 45,000 cargo ships move 10 to 12 billion tons of water from port to port around the world every year. In them, Carlton estimates, "5,000 or more species could easily be in motion on any given day." Ballast water delivered the comb jelly to the Black Sea and the zebra mussel to the Great Lakes. It reportedly dumped an Asian strain of cholera bacteria in Peru, triggering a 1991 epidemic that killed 10,000 people.

Slowly—"far too slowly," Andy Cohen says—New Zealand, the U.S., Norway, and a few other countries are adopting regulations that require ships to exchange their ballast water while out at sea, so coastal species from one port won't get dumped out in another. But the regulations have loopholes big enough to steer a tanker through. Better than ballast exchange, Cohen says, is ballast water treatment. Washington State, which now relies on ballast exchange, will require ships to have installed on-ship treatment systems by 2007. In the meantime an ever changing biological soup of species is ballasted, deballasted, and reballasted every day in every major port in the world.

"I like to use the quote credited to Winston Churchill," Linda Drees, a National Park Service invasive species expert, tells me. "You can always count on the Americans to do the right thing after they've exhausted all the other possibilities."

Exhibit A: North Dakota's nemesis, a yellow-topped, tap-rooted Asian perennial called leafy



MELALEUCA QUINQUENERVIA

Today South Africa employs more than 20,000 people felling and uprooting water-hogging invasive trees.

Aerial spraying killed a dense stand of once leafy Australian melaleuca trees (above) in the wetlands of Florida's Lake Okeechobee. "Our success against melaleuca shows it is possible to control exotic plants," says François Laroche of the South Florida Water Management District. On Long Island, New York, volunteers Linn Johnson (right, at right) and Brian Moran rip mugwort and other weeds out of a school-owned meadow to strengthen native plants that survive there.



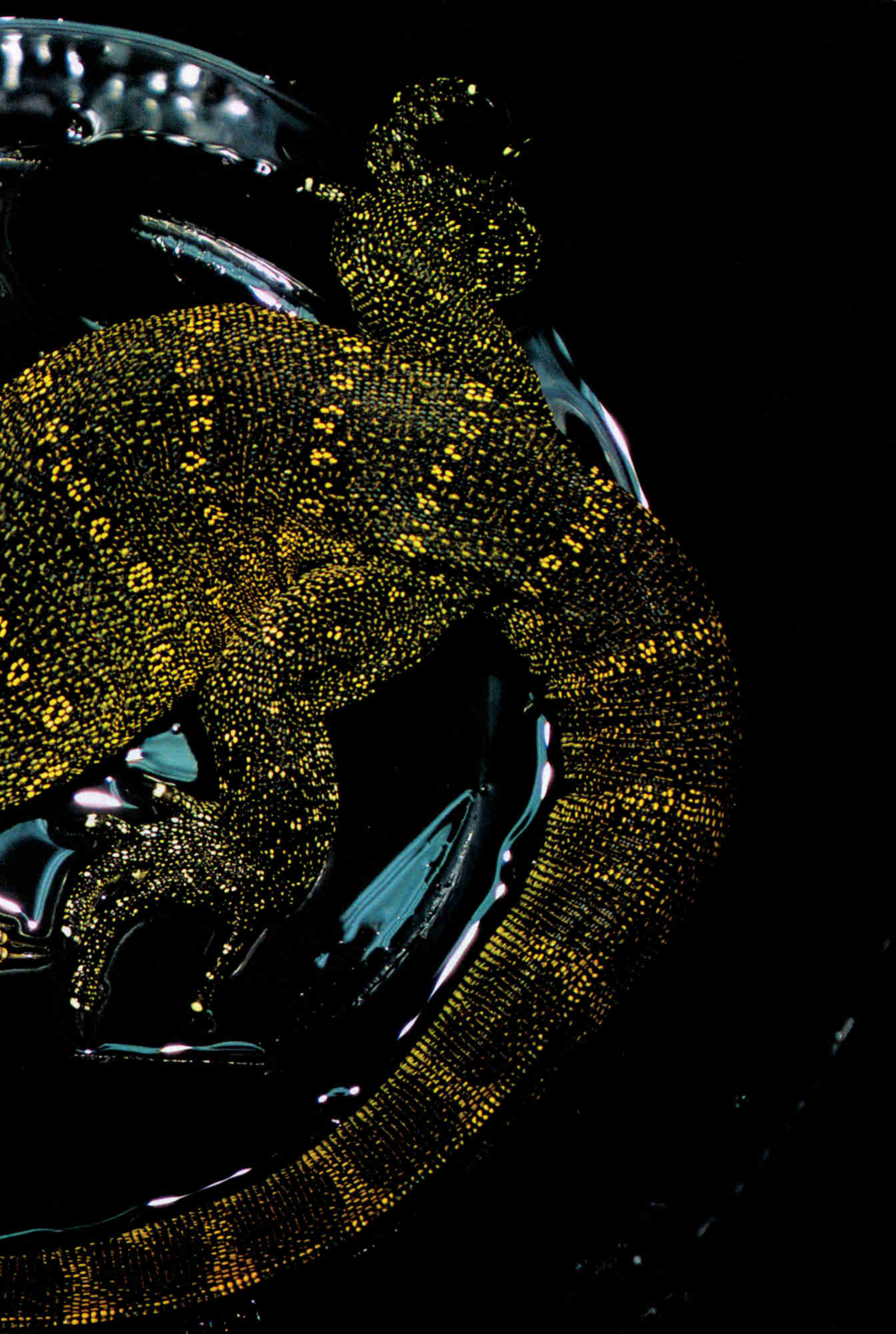
ARTEMISIA VULGARIS

A close-up photograph of a Nile monitor lizard (Varanus niloticus) inside a metal trash can. The lizard's scales are highly iridescent, reflecting a spectrum of colors from blue to yellow and orange. The trash can is made of dark metal and is partially filled with water, which is visible at the bottom. The background is dark, making the lizard's shimmering scales stand out.

exterminate

Gleaming like a hoard of jewels, a captured five-foot Nile monitor lizard awaits death in a trash can in Cape Coral, Florida, where the aggressive former pets run wild. "Somebody put us in the really bad position of having to kill these beautiful animals," says Todd Campbell, ecology professor at the University of Tampa, director of this trapping program.

VARANUS NILOTICUS



spurge. It hit the Great Plains in 1909 and found there broken, overgrazed ground and nary an animal, vegetable, or mineral that could stop it. It galloped away across the prairies, spreading by root and spreading by seed, eventually infesting 1.2 million acres in North Dakota alone.

“Cattle hate spurge,” explains Chuck Weiser, a Ward County, North Dakota, weed board member. “It has an acrid sap that burns their mouths.” One stem in a square foot of pasture reduces grazing in that spot by 50 percent; two stems reduce it by 90 percent. Three stems and “cattle won’t even walk in it.”

Today spurge costs the Dakotas, Montana, and Wyoming an estimated 144 million dollars a year in lost revenues and direct expenses. Alberta, Manitoba, and Saskatchewan are similarly afflicted. North Dakota declared spurge a noxious weed in 1935, requiring ranchers to control it. But “herbicides won’t eradicate it,” Weiser says. “And you can’t pull it up. The root can grow 20 feet deep.”

By the early 1980s the situation in North Dakota was so desperate that local, state, and federal agencies, universities, and landowners came together. They committed to tackling spurge with a model that has produced results elsewhere: develop a strategy, coordinate with other agencies, devote adequate resources, and never let up. Florida used this model, finally, to control the melaleuca tree. New Zealand has used it to eradicate rats on some Pacific Islands. Australia used it to eliminate kochia weed from 8,000 acres.

In North Dakota, counties started sharing ranchers’ herbicide costs. The state studied what grazing sheep could accomplish (spurge tastes just fine to them) and imported thousands of sheep from drought-riven Texas, shepherds and all, and parceled them out to ranchers.

Federal agencies in the U.S. and Canada ramped up efforts to find an insect or pathogen that could control spurge. In 1988 they hit pay dirt. *Aphthona* flea beetles, when released in great numbers, “will knock a hole in spurge,” Weiser says. “The larvae eat their way into the root system and weaken the plant.” Fungi and bacteria finish the job.

Biocontrol is an ancient idea—the Chinese used predacious ants to keep herbivorous insects from grain stores thousands of years ago, and a desire for rodent control undoubtedly

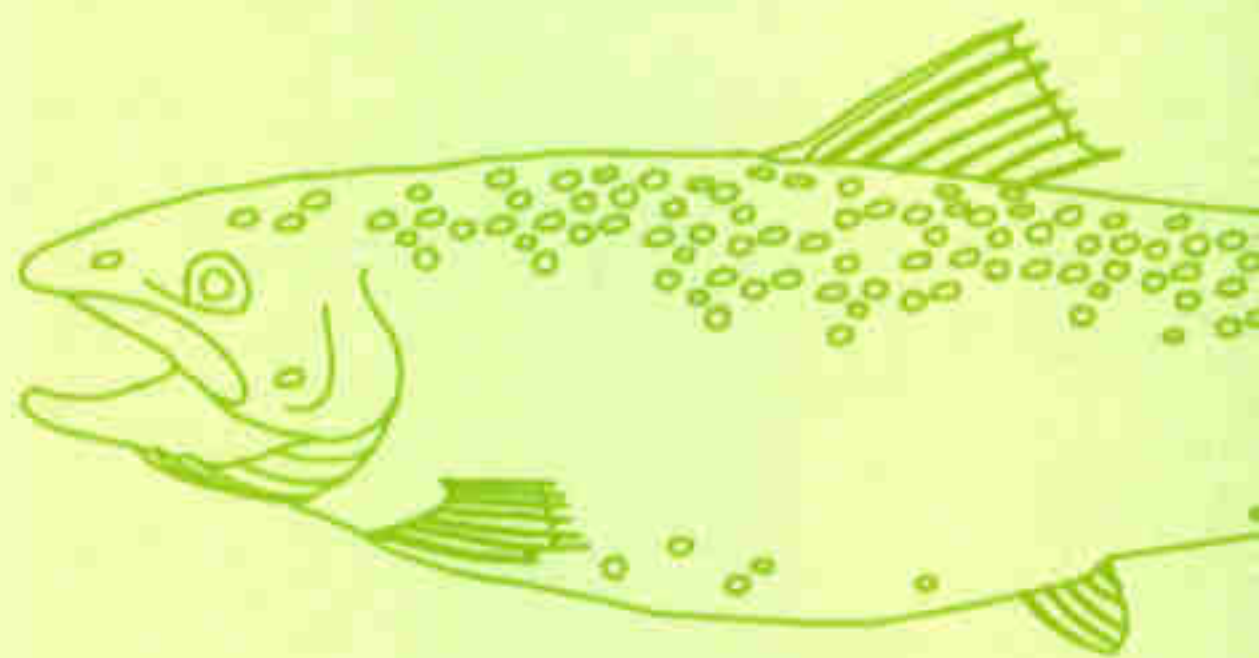


Asian tiger mosquito

100

least wanted

Not all invasives are created equal. Meet some of the worst.



Rainbow trout

WHERE ARE THESE INVASIVES?

■ Profiles of the world's 100 least wanted and a state-by-state rundown on U.S. invasives.

■ Which creatures keep you in battle mode?

Join our forum. Then read about the photographer's experiences. All this and more at nationalgeographic.com/magazine/0503.

Microorganism

- Avian malaria (*Plasmodium relictum*)
- Banana bunchy top virus (*Banana bunchy top virus*)
- Chestnut blight (*Cryphonectria parasitica*)
- Crayfish plague (*Aphanomyces astaci*)
- Dutch elm disease (*Ophiostoma ulmi*)
- Frog chytrid fungus (*Batrachochytrium dendrobatidis*)
- Phytophthora root rot (*Phytophthora cinnamomi*)
- Rinderpest virus (*Rinderpest virus*)

Aquatic Plant

- Caulerpa seaweed (*Caulerpa taxifolia*)
- Common cordgrass (*Spartina anglica*)
- Wakame seaweed (*Undaria pinnatifida*)
- Water hyacinth (*Eichhornia crassipes*)

Land Plant

- African tulip tree (*Spathodea campanulata*)
- Black wattle (*Acacia mearnsii*)
- Brazilian pepper tree (*Schinus terebinthifolius*)
- Cluster pine (*Pinus pinaster*)
- Cogon grass (*Imperata cylindrica*)
- Erect prickly pear (*Opuntia stricta*)
- Fire tree (*Myrica faya*)
- Giant reed (*Arundo donax*)
- Gorse (*Ulex europaeus*)
- Hiptage (*Hiptage benghalensis*)
- Japanese knotweed (*Fallopia japonica*)
- Kahili ginger (*Hedychium gardnerianum*)
- Koster's curse (*Clidemia hirta*)
- Kudzu (*Pueraria montana*)
- Lantana (*Lantana camara*)
- Leafy spurge (*Euphorbia esula*)
- Leucaena (*Leucaena leucocephala*)
- Melaleuca (*Melaleuca quinquenervia*)
- Mesquite (*Prosopis glandulosa*)
- Miconia (*Miconia calvenscens*)
- Mile-a-minute weed (*Mikania micrantha*)
- Mimosa (*Mimosa pigra*)
- Privet (*Ligustrum robustum*)
- Pumpwood (*Cecropia peltata*)
- Purple loosestrife (*Lythrum salicaria*)
- Quinine tree (*Cinchona pubescens*)
- Shoebuttan ardisia (*Ardisia elliptica*)
- Siam weed (*Chromolaena odorata*)
- Strawberry guava (*Psidium cattleianum*)
- Tamarisk (*Tamarix ramosissima*)
- Wedelia (*Sphagneticola trilobata*)
- Yellow Himalayan raspberry (*Rubus ellipticus*)

Aquatic Invertebrate

- Chinese mitten crab (*Eriocheir sinensis*)
- Comb jelly (*Mnemiopsis leidyi*)
- Fish hook flea (*Cercopagis pengoi*)
- Golden apple snail (*Pomacea canaliculata*)
- Green crab (*Carcinus maenas*)
- Marine clam (*Potamocorbula amurensis*)
- Mediterranean mussel (*Mytilus galloprovincialis*)
- Northern Pacific sea star (*Asterias amurensis*)
- Zebra mussel (*Dreissena polymorpha*)

Land Invertebrate

- Argentine ant (*Linepithema humile*)
- Asian long-horned beetle (*Anoplophora glabripennis*)
- Asian tiger mosquito (*Aedes albopictus*)
- Big-headed ant (*Pheidole megacephala*)
- Common malaria mosquito (*Anopheles quadrimaculatus*)
- Common wasp (*Vespula vulgaris*)
- Crazy ant (*Anoplolepis gracilipes*)
- Cypress aphid (*Cinara cupressi*)
- Flatworm (*Platydemus manokwari*)
- Formosan subterranean termite (*Coptotermes formosanus shiraki*)
- Giant African snail (*Achatina fulica*)
- Gypsy moth (*Lymantria dispar*)
- Khapra beetle (*Trogoderma granarium*)
- Little fire ant (*Wasmannia aropunctata*)
- Red imported fire ant (*Solenopsis invicta*)
- Rosy wolf snail (*Euglandina rosea*)
- Sweet potato whitefly (*Bemisia tabaci*)

Amphibian

- Bullfrog (*Rana catesbeiana*)
- Cane toad (*Bufo marinus*)
- Caribbean tree frog (*Eleutherodactylus coqui*)

Fish

- Brown trout (*Salmo trutta*)
- Carp (*Cyprinus carpio*)
- Largemouth bass (*Micropterus salmoides*)
- Mozambique tilapia (*Oreochromis mossambicus*)
- Nile perch (*Lates niloticus*)
- Rainbow trout (*Oncorhynchus mykiss*)
- Walking catfish (*Clarias batrachus*)
- Western mosquito fish (*Gambusia affinis*)

Bird

- Indian myna bird (*Acridotheres tristis*)
- Red-vented bulbul (*Pycnonotus cafer*)
- Starling (*Sturnus vulgaris*)

Reptile

- Brown tree snake (*Boiga irregularis*)
- Red-eared slider turtle (*Trachemys scripta*)

Mammal

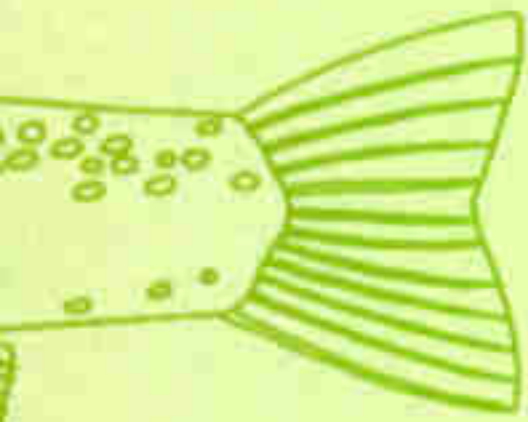
- Brush-tail possum (*Trichosurus vulpecula*)
- Domestic cat (*Felis catus*)
- Goat (*Capra hircus*)
- Gray squirrel (*Sciurus carolinensis*)
- Macaque monkey (*Macaca fascicularis*)
- Mouse (*Mus musculus*)
- Nutria (*Myocastor coypus*)
- Pig (*Sus scrofa*)
- Rabbit (*Oryctolagus cuniculus*)
- Red deer (*Cervus elaphus*)
- Red fox (*Vulpes vulpes*)
- Ship rat (*Rattus rattus*)
- Small Indian mongoose (*Herpestes javanicus*)
- Stoat (*Mustela erminea*)



Water hyacinth



Chinese mitten crab



Cane toad



Tamarisk



Gray squirrel

prompted domestication of the cat—but it's one with a rather mixed record. A moth aptly named *Cactoblastis cactorum* tamed 16 million acres of prickly pear cactus infesting the Australian outback. But a weevil introduced to subdue invasive musk thistle in the U.S. is clobbering native thistles. Research and testing of biocontrol agents are extremely expensive. And even effective biocontrols rarely accomplish the job on their own.

The flea beetles used to combat spurge, for example, are no magic bullet. They don't work in sandy soil, they don't perform in cool weather, and they can take years—as many as ten—to reduce really bad infestations. The best approach, experts say, is integrated pest management (IPM),

It will take worldwide political action to tackle the problem of invasives, Lodge and others believe. They suggest that the new, more stringent security measures being instituted in the U.S. to prevent terrorist activity offer an opportunity. Invasive species control measures could be piggybacked onto them. Military experts might welcome such collaboration. A 2004 article in *Parameters*, the U.S. Army War College quarterly, warns that terrorists could use invasives as weapons to “disrupt and demoralize the U.S. government and its citizens over time.”

Individual action is needed too. “Roll up your sleeves and get out there,” urges Dan Simberloff of Tennessee University. Many people have.

“Invasives aren't like other forms of pollution. They don't stop spreading when you stop releasing them. They grow.”

combining, in this case, sheep and bugs and herbicides where needed. In North Dakota, research is showing that IPM has an added advantage: grazing two or more species, sheep and cattle, for instance, and managing the amount of time each spends on a given patch of land, increases the biodiversity of the grasses and improves soil, strengthening the land's ability to resist invaders.

It's too soon to declare victory, but for the first time in almost a century, spurge in North Dakota is on the wane.

Integrated pest management is a good approach to controlling established invaders, Jim Carlton says. But better yet is “integrated vector management—preventing invasives by managing every footstep of the pathway that brings a species from Brazil to France or from Hong Kong to San Diego. People always ask me, ‘Hasn't everything that *can* be introduced already *been* introduced?’” Carlton says. “Well, there's a European fouling invertebrate called a sea squirt, *Asciidiella aspersa*, that's probably been on the hull of thousands of European ships over 500 years of shipping. But it only showed up for the first time in a New England bay in the 1980s. Based on that time line, I'd say no: Everything that can invade has not invaded, and we can't afford to let it.”

Leahi Santos, 5, has her nonindigenous Cayuga ducks in a row—ready to feast on the invasive golden apple snails that infest her family's taro crop. Although the ducks are the family's most effective weapon against the snails, Hawaii no longer allows Cayuga importation—fearing that they may themselves become invasive, interbreeding with or displacing native ducks (just as the exotic plants along this path have overwhelmed native plants). So taro farms may soon join the casualties of mankind's urge to tinker with nature's balance.



Perhaps you've hiked past them in parks, or seen them by the side of the road, wrestling honeysuckle or Himalayan blackberry. What may look like a hopeless battle and a lousy way to spend a Sunday yields results. Volunteers battle Scotch broom in Washington's Olympic Peninsula region most every Tuesday, rain or shine; there's still Scotch broom, but no longer so much of it as to bar the flight of prairie butterflies. In the Waikamoi Preserve on Maui, Nature Conservancy volunteers have weeded kahili ginger from the forest floor one Saturday a month, every month, for 14 years. As a result of their work, rare native ferns and mosses are still luxuriant on the ground there. In the grandest weed-pulling project of all, South Africa employs more than 20,000 people felling and uprooting waterhogging invasive trees. It's a program that has restored water to streambeds—and self-respect to impoverished, long-out-of-work citizens, many of them women.

It's been 15 years now since the U.S. entered the period Jim Carlton likes to call A.Z.M.—after zebra mussels. At a shocking cost to economies and to nature, we've learned what damage invasives can do. Some of it is permanent. No amount of ballast water exchange is going to eradicate zebra mussels from the Great Lakes. No fumigating of shipping pallets will reinstate the American chestnut, king of North America's eastern forests, felled by an invasive fungus. Many ecosystems are simply changed beyond recognition; for them, there's no going back.

But what we still have is infinitely precious. To sit by and watch it destroyed would be worse than foolish; future generations will call it unforgivable. □

JOIN DETECTIVES in tracking down alien species in *Invaders*, the first episode of *National Geographic's Strange Days on Planet Earth*, an award-winning four-part series premiering on PBS Wednesdays, April 20 and 27.





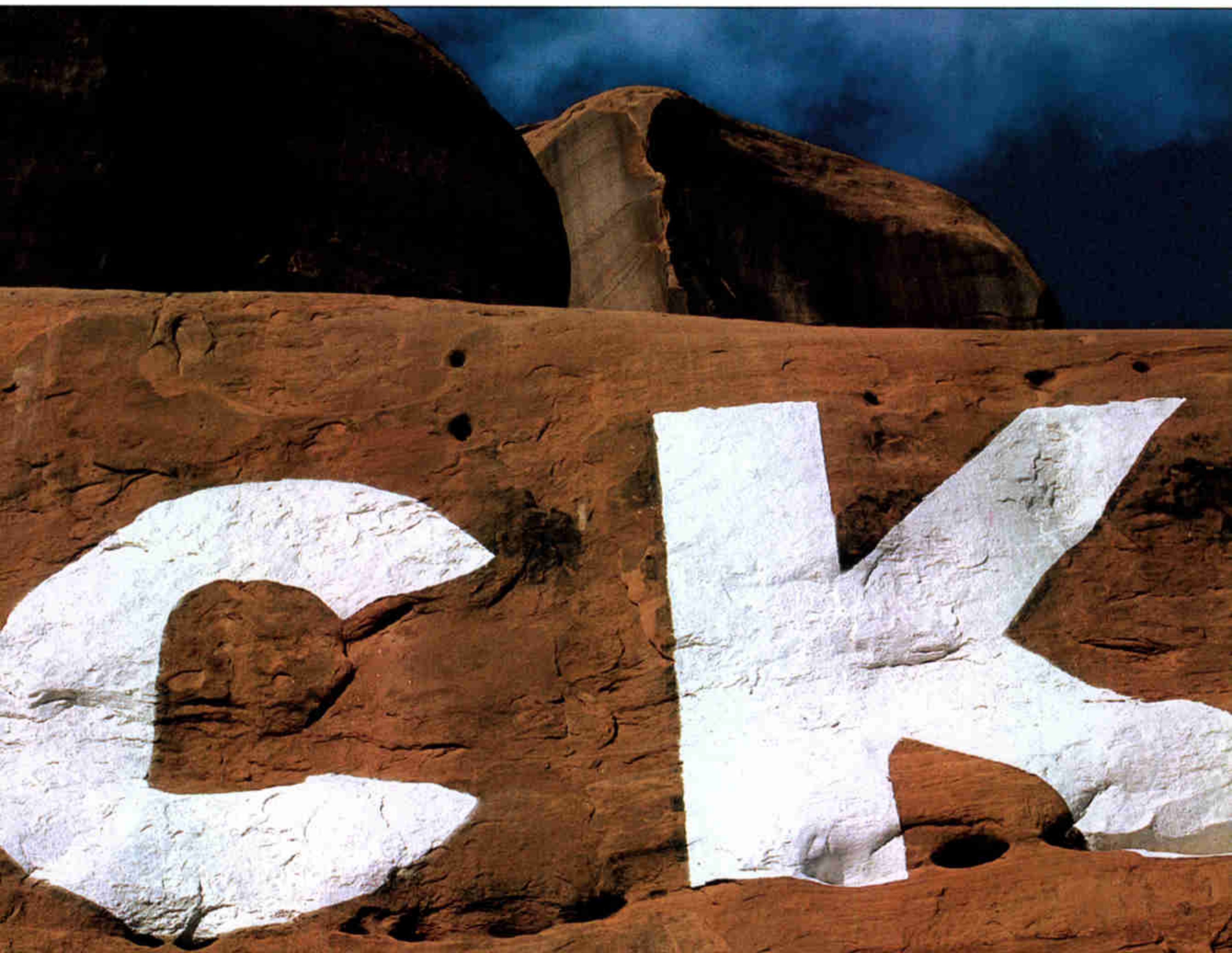
84532

Writing on the Land

BY JUDITH WOLINSKY STEINBERGH
PHOTOGRAPHS BY CARY WOLINSKY

A poet and photographer, sister and brother, celebrate the landscape around Moab, Utah. There, sediments, uplift, wind, water, and people from prehistoric times on have painted, chiseled, eroded, and recorded the story of the red-rock wilderness. A modern inhabitant sculpted the head of FDR outside Hole 'N the Rock, a 14-room home blasted out of stone.





Moab and the red-rock wilderness—

a land of writers and riders, a story so visible
we read what is written everywhere we look:

Layered deposits, the uplift, the fault line,
anticline and arch inscribe a geologic tale. The silent script
of the Green and Colorado Rivers carves the canyons.

Wind moans and wails, battering rocks;
water seeps, freezes, thaws, eroding fins of sandstone,
prying great chunks and slabs from the cliffs to fling down on talus.

Rock art of the ancients pecked and chiseled into Wingate cliffs
depicts their passage through the valleys where granaries and dwellings
blend into caves and alcoves of the canyon walls.

Mines abandoned, mounds of tailings,
rails and truck roads web the land, and still
potash settles in surreal blue ponds beneath red bluffs.

Mule deer, coyote, kit fox imprint the soil under cottonwoods;
we humans, our words and whims, our footprints and tire treads,
track the red-rock expanse with our permanent stamp.



Open Range

Scrublands dotted with saltbush, blackbrush, rabbitbrush, gray-green now in spring, stretch out over valleys and hills to the horizon, leap over the dry washes.

Old junipers with frosted berries twist their silvery trunks, piñon pines clutch fatty nuts in rose-shaped cones, brittle thistle tumbles, and sage, sage, ubiquitous dusty green, its pungent scent hovers over the desert.

Bright dabs of color stain the pastel mesas: prickly pear sprouts its saffron flower, and claret cup wears a blood-red bloom, locoweed, scorpionweed, curly dock, desert holly, Mormon tea, spiky yucca, and poison datura—
a garden for the cautious.

Black Angus graze like dark cutouts against blue sky. A road sign shows a cow, says Open Range. Bullet holes let the sun shine through.

1. Common paintbrush near Arches National Park
2. Evaporation ponds at Intrepid Potash company
3. Desert elkweed
4. Cattle sign on Highway 128



NEARLY 300 MILLION YEARS AGO

Marine creatures thrived in a warm, shallow sea.

150 MILLION YEARS AGO

Dinosaurs lumbered across semiarid savanna.

8,000 YEARS AGO

Nomadic hunter-gatherers created rock art and made tools.

Written on Rock

News over news over millennia.
Ghostly scarlet figures,
prints of hands repeated
on the sheer walls, petroglyphs
pecked into the sheen
beneath rock overhangs.

We are drawn to them. Face-to-face
with bighorn sheep, antelope, and snakes.

We are inches from six-toed footprints,
bear tracks and centipede, the shaman, his headdress,
shields of warriors, odd humans holding hands.
Spirals and circles of power or population?
Zigzags of rivers or lightning?
White dots carefully spaced to show
how long they stayed, how far the water?

A large bear is chiseled
far above the road;
men on horseback aim arrows
at its belly, back, and nose.
Boys' names are scratched
nearby; bullet holes pierce
the bear's body, shattering rock.
So many passing have left a mark.
Who, though, shoots at art?

Climber

Harnessed,
hands chalked,
sling of biners
and quickdraws,
she reaches, fingers
a narrow ledge,
toes a foothold,
wedges
her body into
the crevice
of rock,
inches upward
against
the mesa's face,
stretches to an old bolt,
its webbing dangles,
a prayer flag.
Below,
her friend belays.
Patient work,
intimate, hoping
the rock will give,
receive her
safely, allow
a mortal visitor
to feel its
morning heat.

Peekaboo Arch, Salt Creek Canyon

2,000 YEARS AGO

Anasazi and early Fremont people settled in the canyonlands, adopting agricultural practices.

700 YEARS AGO

Navajo migrated from the north, joining the Ute and Paiute, who had arrived earlier.

125 YEARS AGO

Mormons settled in the region, naming it after the biblical land beyond the Jordan.

Red Rocks

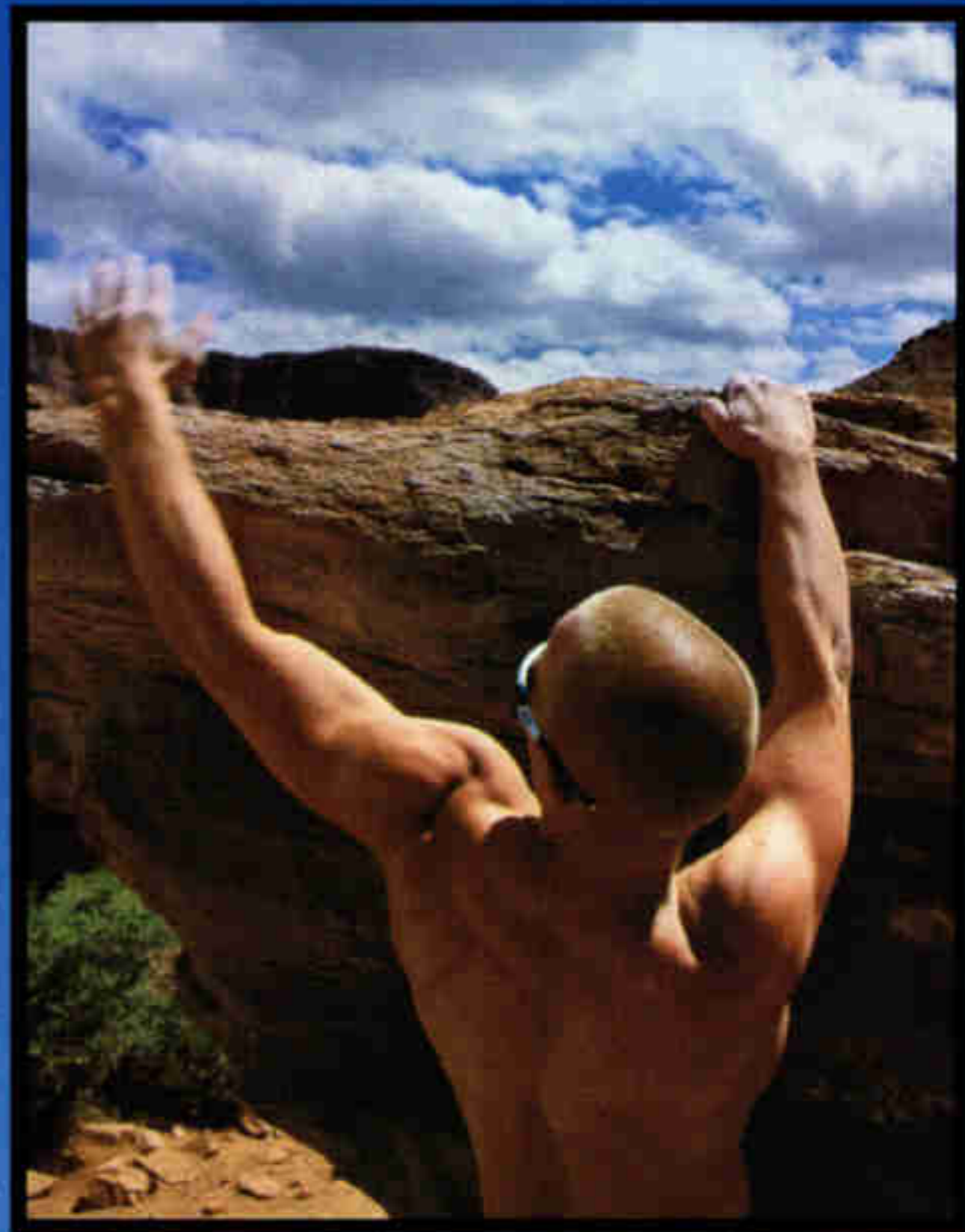
Three hundred million years of the Earth's making are written here on red rock, faces smooth or swirled, streaked, striped, or banded, creased and creviced, scoured and pocked, sculpted into figure, frieze, and phallus, tower and spire, chimney, mesa, bluff and butte, rust red against Utah's cobalt sky.

Red rock scarred, or stained black and silvery slate with "desert varnish" by microbes grasping minerals from the air.

Rocks reddened by traces of iron, fissured and finned, eroded into shapes named mushroom, goblin, hoodoo, evoke a sacred space. This stark, vast, dry, and fragile place is slow to change, impossible to repair.

Red rock stretches away to the horizon or falls sharply to the secret canyon floor, presses in, blots out patches of azure sky, slices off light, forces our thoughts inside.

We humans have never been so small as we are here. □



Courthouse Towers, Arches National Park
Bouldering at Big Bend (above)

NOW

Among a multitude of creatures in the sparse yet adaptable vegetation live ranchers and rangers, miners, drillers, guides and gazers, adventurers and thrill seekers—people who long to be close to the wild.

► Find more 84532 poems, images, and resources at nationalgeographic.com/magazine/0503.

FOOD AND FAMILY.
The 2 sources of cholesterol.



Uncle Doug, Branson Mo. 3/85

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VYTORIN helps block the absorption of cholesterol that comes from food *and* reduces the cholesterol that your body makes naturally. And VYTORIN can dramatically lower your bad cholesterol 45%–60%.

(Average effect depending on dose. 52% at the usual starting dose.)

Ask your doctor about VYTORIN.

Important information: VYTORIN is a prescription tablet and isn't right for everyone, including women who are nursing or pregnant or who may become pregnant, and anyone with liver problems. Unexplained muscle pain or weakness could be a sign of a rare but serious side effect and should be reported to your doctor right away. VYTORIN may interact with other medicines or certain foods, increasing your risk of getting this serious side effect. So, tell your doctor about any other medications you are taking.

To learn more, call
1-877-VYTORIN or visit vytorin.com

Please read the Patient Product
Information on the adjacent page.



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VYTORIN[™]
(ezetimibe/simvastatin)

Treat the 2 sources of cholesterol.

VYTORIN™ (ezetimibe/simvastatin) Tablets

Patient Information about VYTORIN (VI-tor-in)

Generic name: ezetimibe/simvastatin tablets

Read this information carefully before you start taking VYTORIN. Review this information each time you refill your prescription for VYTORIN as there may be new information. This information does not take the place of talking with your doctor about your medical condition or your treatment. If you have any questions about VYTORIN, ask your doctor. Only your doctor can determine if VYTORIN is right for you.

What is VYTORIN?

VYTORIN is a medicine used to lower levels of total cholesterol, LDL (bad) cholesterol, and fatty substances called triglycerides in the blood. In addition, VYTORIN raises levels of HDL (good) cholesterol. It is used for patients who cannot control their cholesterol levels by diet alone. You should stay on a cholesterol-lowering diet while taking this medicine.

VYTORIN works to reduce your cholesterol in two ways. It reduces the cholesterol absorbed in your digestive tract, as well as the cholesterol your body makes by itself. VYTORIN does not help you lose weight.

Who should not take VYTORIN?

Do not take VYTORIN:

- If you are allergic to ezetimibe or simvastatin, the active ingredients in VYTORIN, or to the inactive ingredients. For a list of inactive ingredients, see the "Inactive ingredients" section at the end of this information sheet.
- If you have active liver disease or repeated blood tests indicating possible liver problems.
- If you are pregnant, or think you may be pregnant, or planning to become pregnant or breast-feeding.

VYTORIN is not recommended for use in children under 10 years of age.

What should I tell my doctor before and while taking VYTORIN?

Tell your doctor right away if you experience unexplained muscle pain, tenderness, or weakness. This is because on rare occasions, muscle problems can be serious, including muscle breakdown resulting in kidney damage.

The risk of muscle breakdown is greater at higher doses of VYTORIN.

The risk of muscle breakdown is greater in patients with kidney problems.

Taking VYTORIN with certain substances can increase the risk of muscle problems. It is particularly important to tell your doctor if you are taking any of the following:

- cyclosporine

- danazol
- antifungal agents (such as itraconazole or ketoconazole)
- fibric acid derivatives (such as gemfibrozil, bezafibrate, or fenofibrate)
- the antibiotics erythromycin, clarithromycin, and telithromycin
- HIV protease inhibitors (such as indinavir, nelfinavir, ritonavir, and saquinavir)
- the antidepressant nefazodone
- amiodarone (a drug used to treat an irregular heartbeat)
- verapamil (a drug used to treat high blood pressure, chest pain associated with heart disease, or other heart conditions)
- large doses (≥ 1 g/day) of niacin or nicotinic acid
- large quantities of grapefruit juice (>1 quart daily)

It is also important to tell your doctor if you are taking coumarin anticoagulants (drugs that prevent blood clots, such as warfarin).

Tell your doctor about any prescription and nonprescription medicines you are taking or plan to take, including natural or herbal remedies.

Tell your doctor about all your medical conditions including allergies.

Tell your doctor if you:

- drink substantial quantities of alcohol or ever had liver problems. VYTORIN may not be right for you.
- are pregnant or plan to become pregnant. Do not use VYTORIN if you are pregnant, trying to become pregnant or suspect that you are pregnant. If you become pregnant while taking VYTORIN, stop taking it and contact your doctor immediately.
- are breast-feeding. Do not use VYTORIN if you are breast-feeding.

Tell other doctors prescribing a new medication that you are taking VYTORIN.

How should I take VYTORIN?

- Take VYTORIN once a day, in the evening, with or without food.
- Try to take VYTORIN as prescribed. If you miss a dose, do not take an extra dose. Just resume your usual schedule.
- Continue to follow a cholesterol-lowering diet while taking VYTORIN. Ask your doctor if you need diet information.
- Keep taking VYTORIN unless your doctor tells you to stop. If you stop taking VYTORIN, your cholesterol may rise again.

What should I do in case of an overdose?

Contact your doctor immediately.

What are the possible side effects of VYTORIN?

See your doctor regularly to check your cholesterol level and to check for side effects. Your doctor may do blood tests to check your liver before you start taking VYTORIN and during treatment.

In clinical studies patients reported the following common side effects while taking VYTORIN: headache and muscle pain (see What should I tell my doctor before and while taking VYTORIN?).

The following side effects have been reported in general use with either ezetimibe or simvastatin tablets (tablets that contain the active ingredients of VYTORIN):

- allergic reactions including swelling of the face, lips, tongue, and/or throat that may cause difficulty in breathing or swallowing (which may require treatment right away), and rash; alterations in some laboratory blood tests; liver problems; inflammation of the pancreas; nausea; gallstones; inflammation of the gallbladder.

Tell your doctor if you are having these or any other medical problems while on VYTORIN. This is not a complete list of side effects. For a complete list, ask your doctor or pharmacist.

General Information about VYTORIN

Medicines are sometimes prescribed for conditions that are not mentioned in patient information leaflets. Do not use VYTORIN for a condition for which it was not prescribed. Do not give VYTORIN to other people, even if they have the same condition you have. It may harm them.

This summarizes the most important information about VYTORIN. If you would like more information, talk with your doctor. You can ask your pharmacist or doctor for information about VYTORIN that is written for health professionals. For additional information, visit the following web site: vytorin.com.

Inactive ingredients:

Butylated hydroxyanisole NF, citric acid monohydrate USP, croscarmellose sodium NF, hydroxypropyl methylcellulose USP, lactose monohydrate NF, magnesium stearate NF, microcrystalline cellulose NF, and propyl gallate NF.

Issued November 2004



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Final Edit



FREDERICK LAW OLMSTED

Central Barkers

When veteran photographer Melissa Farlow was asked to illustrate the vision of America's great park designer Frederick Law Olmsted, she found herself faced with a dilemma: Should she show the lovely historical touches that remain in Olmsted's parks or show the fruits of his labors—city folk enjoying the natural spaces he so passionately believed they needed?

The answer revealed itself on a rainy summer afternoon as she strolled through Central Park, the project that launched Olmsted's career. Storm clouds parted, bathing the park in heavenly light and drawing residents from their high-rise shelters. A man on Gapstow Bridge caught her eye. "He looked like a regular Joe New Yorker," Farlow recalls. "Someone who lived nearby and walked his dogs here every day." She snapped the shutter in the fading light, capturing a feeling Olmsted would have surely understood: A man and his dogs simply enjoying Manhattan's big beautiful backyard.

CUT IT OR KEEP IT?

E-greet a friend with the image above and find the Editor's runner-up choice for Final Edit at nationalgeographic.com/magazine/0503.

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20	11.46	10.76	12.25	11.38	19.25	17.50	33.25	29.75	51	24.06	19.25	37.84	28.00	70.44	50.75	121.63	95.38
21	11.46	10.76	12.25	11.38	19.25	17.50	33.25	29.75	52	25.99	20.39	41.34	30.41	77.44	55.56	137.38	105.00
22	11.46	10.76	12.25	11.38	19.25	17.50	33.25	29.75	53	28.00	21.61	45.28	32.59	85.31	59.94	153.13	113.75
23	11.46	10.76	12.25	11.38	19.25	17.50	33.25	29.75	54	29.84	22.75	49.00	34.78	92.75	64.31	169.75	121.63
24	11.46	10.76	12.25	11.38	19.25	17.50	33.25	29.75	55	32.29	24.24	53.81	37.63	102.38	70.00	189.88	133.00
25	11.46	10.76	12.25	11.38	19.25	17.50	33.25	29.75	56	34.91	25.64	59.06	40.25	112.88	75.25	210.00	143.50
26	11.46	10.76	12.25	11.38	19.25	17.50	33.25	29.75	57	38.41	27.91	65.84	44.19	126.44	83.13	237.13	159.25
27	11.46	10.76	12.25	11.38	19.25	17.50	33.25	29.75	58	41.91	30.10	73.06	47.69	140.88	90.13	264.25	174.13
28	11.46	10.76	12.25	11.38	19.25	17.50	33.25	29.75	59	45.41	32.20	80.06	51.41	154.88	97.56	292.25	189.00
29	11.46	10.76	12.25	11.38	19.25	17.50	33.25	29.75	60	49.79	34.83	88.81	56.22	172.38	107.19	326.38	208.25
30	11.46	10.76	12.25	11.38	19.25	17.50	33.25	29.75	61	53.99	37.36	96.91	60.59	188.56	115.94	357.00	224.88
31	11.46	10.76	12.25	11.38	19.25	17.50	33.25	29.75	62	59.50	40.69	108.06	66.50	210.88	127.75	398.13	247.63
32	11.46	10.76	12.25	11.38	19.25	17.50	33.25	29.75	63	65.01	44.01	119.00	72.19	232.75	139.13	439.25	271.25
33	11.46	10.76	12.25	11.38	19.25	17.50	33.25	29.75	64	70.53	47.34	129.94	78.09	254.63	150.94	480.38	293.13
34	11.46	10.76	12.25	11.38	19.25	17.50	33.25	29.75	65	77.44	51.63	143.72	85.53	282.19	165.81	532.00	322.00
35	11.64	10.85	12.47	11.38	19.69	17.50	34.13	29.75	66	85.14	55.30	158.81	91.44	312.38	177.63	592.38	343.88
36	11.81	11.11	12.91	11.59	20.56	17.94	35.00	30.63	67	95.46	58.98	179.16	99.53	353.06	193.81	672.00	373.63
37	12.16	11.29	13.56	12.03	21.88	18.81	37.63	32.38	68	105.79	63.79	199.72	107.41	394.19	209.56	752.50	401.63
38	12.34	11.46	14.00	12.47	22.75	19.69	40.25	34.13	69	116.11	68.43	220.06	115.50	434.88	225.75	833.88	431.38
39	12.69	11.73	14.66	12.91	24.06	20.56	42.88	35.88	70	128.98	73.85	245.44	125.56	485.63	245.88	935.38	469.00
40	12.95	11.90	15.31	13.56	25.38	21.88	45.50	38.50	71	147.79	87.59	283.50	152.69	561.75	300.13	1070.13	576.63
41	13.56	12.43	16.84	14.44	28.44	23.63	50.75	42.00	72	172.81	106.14	334.03	188.78	662.81	372.31	1262.63	713.13
42	14.44	13.04	18.16	15.75	31.06	26.25	56.88	46.38	73	197.84	124.69	384.78	224.88	764.31	444.50	1456.88	850.50
43	15.14	13.74	19.69	17.06	34.13	28.88	63.00	52.50	74	222.86	143.15	435.31	261.19	865.38	517.13	1651.13	988.75
44	16.01	14.35	21.66	18.38	38.06	31.50	70.88	57.75	75	254.19	166.25	498.75	306.25	992.25	607.25	1893.50	1159.38
45	17.06	15.05	23.84	19.91	42.44	34.56	79.63	63.88	76	282.89	187.25	556.72	347.38	1108.19	689.50	2111.38	1317.75
46	17.94	15.49	25.59	20.78	45.94	36.31	84.00	67.38	77	321.21	215.34	634.16	402.06	1263.06	798.88	2429.00	1527.75
47	18.99	16.19	27.56	22.09	49.88	38.94	91.00	72.63	78	359.54	243.43	711.38	456.97	1417.50	908.69	2751.00	1757.88
48	20.13	16.89	29.97	23.41	54.69	41.56	95.38	77.88	79	397.86	271.60	788.81	511.88	1572.38	1018.50	3080.00	1990.63
49	21.26	17.59	32.16	24.72	59.06	44.19	101.50	82.25	80	442.84	301.44	885.72	580.56	1766.19	1155.88	3491.25	2282.88
50	22.66	18.46	34.78	26.47	64.31	47.69	110.25	88.38									

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Do It Yourself

FREDERICK LAW OL MSTED (SEE PAGE 32)

GO THERE

Central Park

Even though he had no prior experience as a landscape architect, Frederick Law Olmsted made quite an impression with his first foray into the field: The Greensward plan for New York City's Central Park set the standard for urban parks across the country. In mid-Manhattan, on swampy and rocky land scattered with shantytowns, Olmsted and his partner, Calvert Vaux, envisioned a bucolic haven open to all classes of people. Their basic design has lasted 150 years. You can amble through the park on your own or get insights into their vision on the year-round guided walks offered by the Central Park Conservancy (212-360-2726 or centralparknyc.org).



Bethesda Terrace Vaux's formal, tree-lined promenade leads to the terrace, considered the architectural heart of the park. From here a quintessential Olmstedian view takes in the Lake, backed by the woodlands of the Ramble.



NG MAPS



North Woods The Catskill Mountains and Hudson River Valley were popular subjects for paintings in the mid-1800s. The park's 90 acres of re-created Adirondack woodlands (above) were Olmsted's landscape version of that art.

Belvedere Castle Italian for "beautiful view," Belvedere is a Gothic fantasy conceived by Olmsted and Vaux to offer a vantage point on the park. It now serves as a nature center.



The Ramble The Bow Bridge (above) leads to the 38-acre Ramble. Olmsted's "wild garden," it's actually orchestrated right down to its stream, turned on by a tap.

Conservatory Water Aspiring admirals have sailed miniature yachts in Olmsted and Vaux's model-boat pond for 140 years. You can either bring your own yacht or rent one at the park.

The Dairy Olmsted and Vaux designed this Gothic-revival chalet as a place for mothers and children to relax over fresh milk and other light refreshments. It now serves as an information center at the southern end of the park.

PICKS

3 books

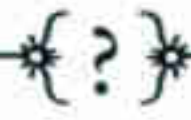
As writer **John Mitchell** explains in his story, Olmsted had several careers before discovering landscape architecture. One venture he did particularly well with was writing. Here are three Olmsted surprises.

■ **Walks and Talks of an American Farmer in England** A trip through England in 1850 ignited Olmsted's interest in public parks. Calvert Vaux read this book and cited it as one of the reasons he asked Olmsted to be his partner on the Central Park project.

■ **A Journey in the Seaboard Slave States** Olmsted wrote this book about his observations of life in the antebellum South in 1857, when he was a reporter for the *New-York Daily Times*.

■ **Defending the Union** Part of a six-volume set of Olmsted's edited papers, this collection was written during the Civil War, when Olmsted served as general secretary of the U.S. Sanitary Commission. It reflects his ideas on abolition and patriotism.

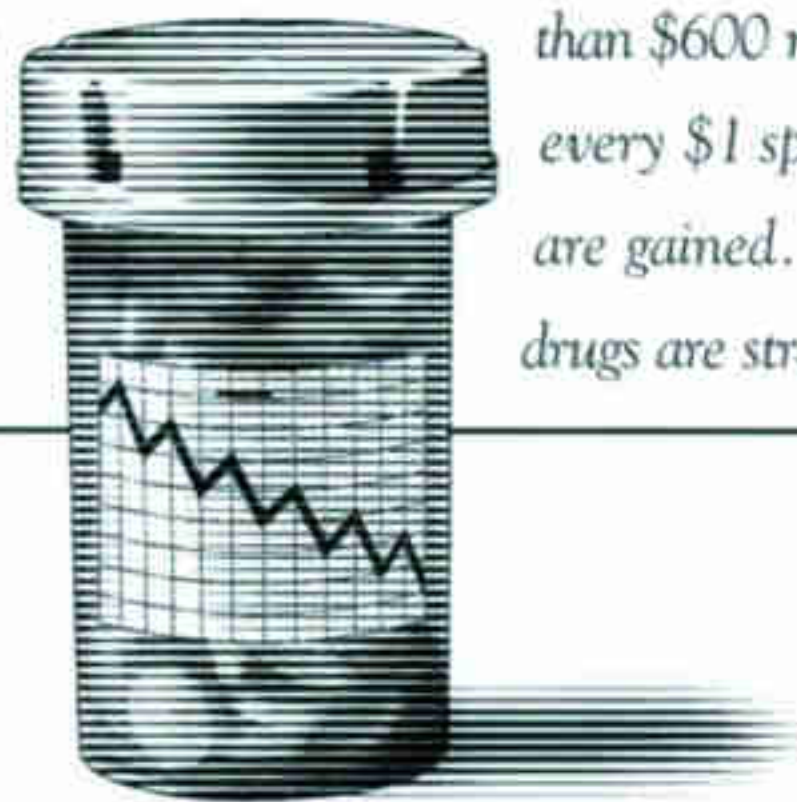
▶ **OLMSTED ACROSS THE U.S.** Find out about other Olmsted parks and projects at nationalgeographic.com/magazine/0503.



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Flashback



F. C. MINOR

FREDERICK LAW OLMSTED

Raising the Roof

An uncapped Capitol building sprawled across its Washington, D.C., site in 1860. Its original copper-clad wooden dome, a fire hazard, had been removed four years earlier to be replaced by what to this day remains one of the world's largest cast-iron domes.

The outbreak of the U.S. Civil War just months after this picture was taken halted projects across the city, but the Capitol construction continued—"a sign," Abraham Lincoln said, "we intend the Union shall go on." Lincoln's own life ended before construction did, and he lay in state beneath the dome's unfinished ceiling in 1865. The dome interior was completed a year later, and in 1874 Frederick Law Olmsted was hired to landscape the Capitol grounds. —Margaret G. Zackowitz

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